Series 1946, No. 4

Issued September 1960

SOIL SURVEY

Upper Flathead Valley Area Montana

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
MONTANA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

This survey of the Upper Flathead Valley Area will serve various groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields, and it will add to the knowledge of soil scientists.

In making this survey, soil scientists walked over the fields and woodlands. They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noticed differences in growth of crops, weeds, and brush; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming, trees, wildlife, and related uses.

The scientists plotted the boundaries of the soils on aerial photographs. Then, cartographers prepared from the photographs the detailed soil map in the back of this report. Fields, woods, roads, streams, and many other landmarks can be seen on the map.

Locating the soils

Use the index to map sheets to locate areas on the large map. The index is a small map of the county at the end of this report on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map is found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. Suppose, for example, an area located on the map has the symbol Ke. The legend for the detailed map shows that this symbol identifies Kalispell loam, 0 to 3 percent slopes. This soil and all others mapped in the Area are described in the section Description of the Soils.

Finding information

Few readers will be interested in all of the soil survey report, for it has special sections for different groups, as well as some sections of value to all. The introductory part has a description of the physiography, relief, drainage, and climate of the Area and will be of interest mainly to readers who are not familiar with the Upper Flathead Valley Area.

Farmers and those who work with farmers will be interested mainly in the section Description of the Soils and in the section Use and Management of Soils. Information in these sections will help in identifying soils on a farm, in learning ways the soils can be managed, and in estimating yields. The Guide to Mapping Units and Capability Units at the end of the report will simplify the use of the map and the report. This guide lists each soil and its map symbol and capability unit and gives the page where the soil and capability unit are discussed.

Soil scientists will find information about how the soils were formed and how they were classified in the section Genesis, Classification, and Morphology of Soils.

Students, teachers, and other users with special interests will find information about soils and their management in various parts of the report.

The Flathead Soil Conservation District at Kalispell arranges for farmers to receive technical help from the Soil Conservation Service in planning good use and conservation of the soils on their farms. The survey furnishes some of the facts needed for this technical help. The soil survey map and report also are useful to land appraisers, credit agencies, road engineers, and to others who are concerned with the use and management of land.

* * *

The fieldwork for this survey was completed in 1946. Unless noted otherwise, all statements refer to conditions at the time of the survey.

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Contents

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SOIL SURVEY OF UPPER FLATHEAD VALLEY AREA, MONTANA

SOILS SURVEYED BY FREDERICK K. NUNNS, MONTANA AGRICULTURAL EXPERIMENT STATION

REPORT BY B. H. WILLIAMS AND R. K. JACKSON, SOIL CONSERVATION SERVICE [1]

CORRELATION BY B. H. WILLIAMS, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH MONTANA AGRICULTURAL EXPERIMENT STATION

MOST OF THE Upper Flathead Valley Area is in Flathead County, but a small part is in the northwestern tip of Lake County. The Area is located in the northwestern part of the State, north of Flathead Lake and immediately west of the Continental Divide. Kalispell, the county seat, is north of Missoula and northwest of Great Falls. Distances by air from Kalispell to principal cities in the State are shown in figure 1.

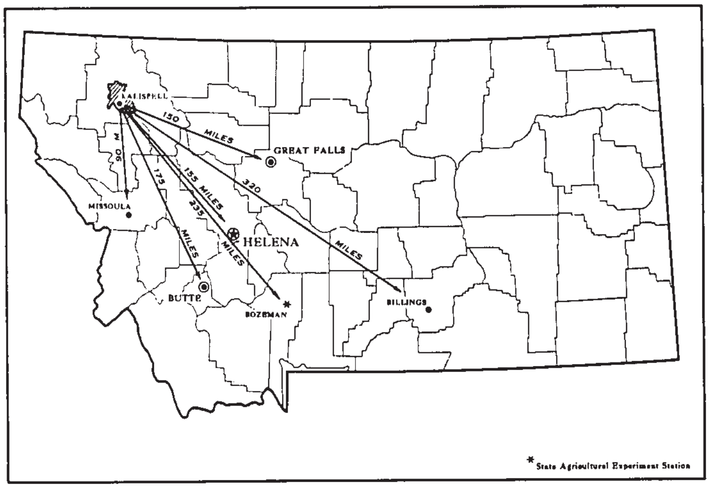

Figure 1.—**Location of Upper Flathead Valley Area in Montana.**

The area surveyed is about 31 miles long and about 14 miles wide. It contains approximately 239,360 acres, or 374 square miles. It includes nearly all the cultivated land in Flathead County and nearly all the potential agricultural soil in the valley except some narrow tongues around the edges. The rolling uplands and mountainous terrain surrounding the area are not suitable for cultivation and are generally used for grazing and forest.

General Description of the Area

This section is provided mainly for those not familiar with the Upper Flathead Valley Area. The first part describes the physiography, relief, drainage, and climate; the second discusses the general soil areas. Details about agriculture will be found in the section Agriculture.

[1] Fieldwork for this survey was done while Soil Survey was a part of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

Physiography, Relief, and Drainage

The Upper Flathead Valley Area lies along the great Rocky Mountain Trench. It is an intermountain valley drained by the Flathead River and its tributaries, the Whitefish, Stillwater, and Swan Rivers. The Flathead River enters the northeastern corner of the Area and flows in a general southerly direction until it passes the eastern edge of Kalispell. South of Kalispell it flows southeast and enters Flathead Lake about 2½ miles west of Bigfork. The Whitefish River flows in a southerly direction, from Whitefish Lake at Whitefish, and enters the Flathead River at the northeastern edge of Kalispell. The Stillwater River enters the northwestern corner of the Area about 6 miles southwest of Whitefish, flows in a southeasterly direction, and joins the Whitefish River near Kalispell. The Swan River enters the southeastern corner of the Area, flows in a general northwesterly direction, and enters Flathead Lake at Bigfork.

Ashley Creek, the most important minor stream, flows from Smith Lake in a northeasterly direction as far as the western limits of Kalispell. From there it flows southeast and enters the Flathead River about 4½ miles north of Somers. There are numerous perennial creeks that flow from the Swan Mountains and feed Blaine, Echo, and Mud Lakes. Lake Blaine is about 9 miles northeast of Kalispell. Echo Lake is about 4 miles northeast and Mud Lake 4½ miles northeast of Bigfork. Both lakes are near the Swan Mountains. Blanchard and Spencer Lakes lie slightly southwest of Whitefish.

The Upper Flathead Valley Area consists of (1) nearly level, alluvial lands, bottom lands, and low terraces along the Flathead, Whitefish, and Stillwater Rivers; (2) high, fairly smooth, lacustrine and glacial stream-laid terraces or benches; (3) morainic hills and ridges; and (4) sloping outwash fans and aprons extending from the adjacent mountains.

Climate [2]

Flathead County is in an area of climatic transition. To the west, the influence of the Pacific Ocean causes wet winters and dry summers. To the east, beyond the Continental Divide, rainfall typical of the Great Plains prevails; the wettest months are early in summer, and the winters are relatively dry. The effect of these two types of climate on the Upper Flathead Valley Area can be shown by comparing the climate at Kalispell, Mont., with that of Spokane, Wash., and Havre, Mont. The climate at Spokane, about 140 miles west-southwest of Kali-

[2] Prepared by WENDELL C. JOHNSON, soil scientist, Soil Conservation Service.

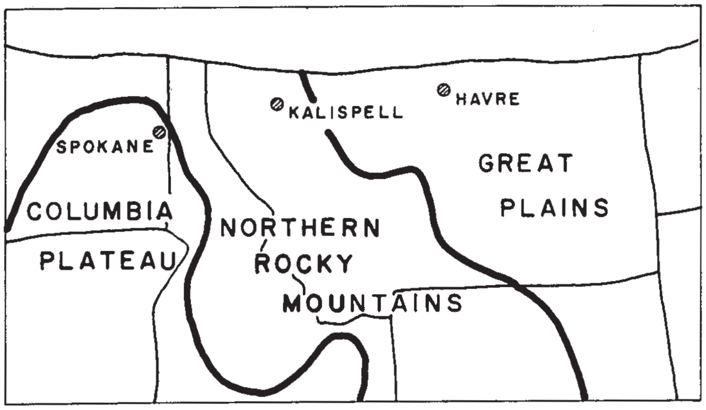

Figure 2.—Location of Spokane, Wash., Kalispell, Mont., and Havre, Mont., in relation to physiographic provinces.

spell, is representative of the Great Basin climate of the northwest. It is influenced by the Pacific Ocean currents and other West Coast climatic factors. The climate at Havre, about 220 miles east-northeast of Kalispell, is typical of the Great Plains (fig. 2).

Precipitation

Distribution of monthly precipitation at Havre, Kalispell, and Spokane is shown in figure 3. The maximum monthly precipitation in Spokane is in November, December, and January, and in Havre it is in June. At Kalispell the precipitation is more uniform throughout the year than at either Spokane or Havre. Kalispell has a precipitation maximum early in summer, like Havre, and, in addition, a secondary maximum about the first of the year, like Spokane. Records show that the amounts of precipitation during summer and winter are not related. The moisture for one of the maximum periods cannot be predicted from the rainfall of the preceding maximum period.

In a mountainous area, climate is controlled to a great extent by local topography. This is especially true of rainfall. Precipitation is caused by the lifting of moist air. As air is lifted, it cools by expansion and releases the moisture, usually as rain or snow. This relationship is complicated, as shown in figure 4. Wind, approaching the mountain slope from the left, begins to rise before the slope is reached. Precipitation increases without an increase in elevation. This is called the approach effect. Along the windward mountain slope, precipitation increases with altitude, but the maximum precipitation may occur below the peak of the mountain.

On the leeward side of the mountains, descending air is warmed by compression, and the precipitation lessens. The moisture-deficient area on the leeward side of the mountain is said to be in a rain shadow.

Storms that bring moisture to the Upper Flathead Valley Area approach from the west, at first moving down the slope. Consequently, precipitation is least along the west side of the valley. The mountains on the east side of the valley rise sharply to a height of about 4,500 feet above the valley floor, and they bring into play the approach effect. The result is that more precipitation occurs along the east and north sides of the valley.

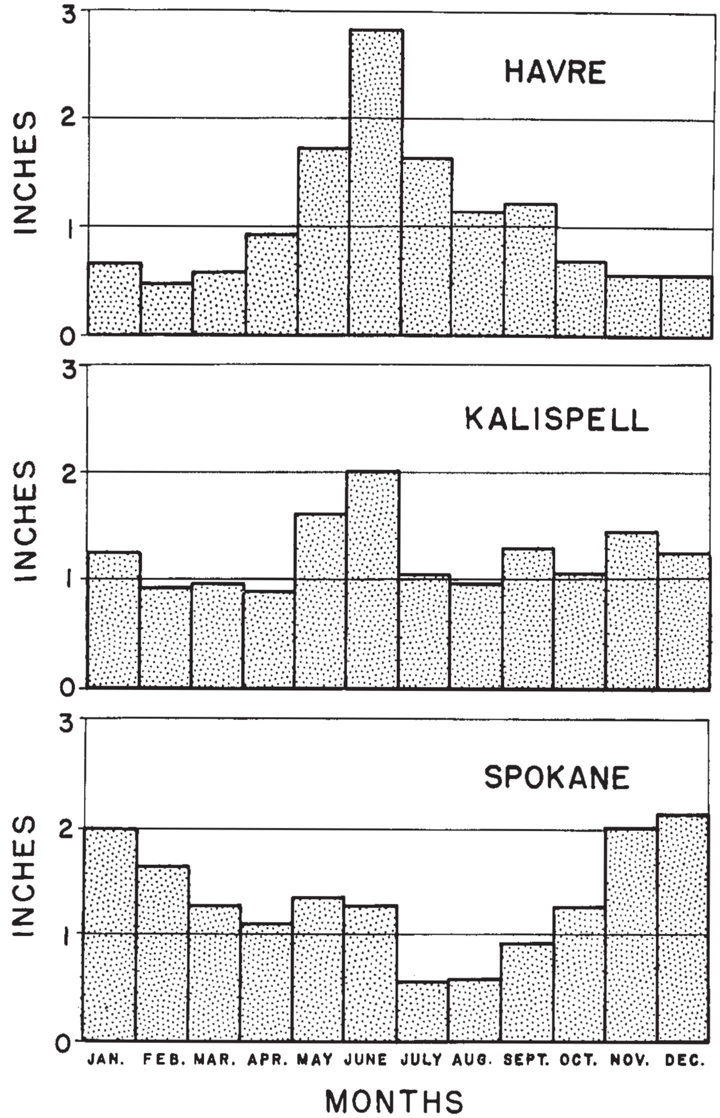

Figure 3.—Distribution of monthly precipitation at Havre, Mont., Kalispell, Mont., and Spokane, Wash.

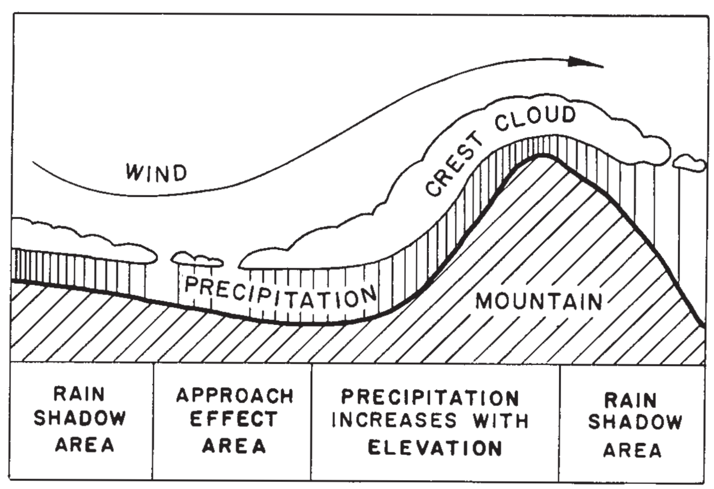

Figure 4.—The effect of topography on precipitation.

The west shore of Flathead Lake and the area southwest of it appear to be in a rain shadow, as they are relatively dry. Columbia Falls and Whitefish have about the same elevation as Kalispell, but they are located more favorably in the northern and northeastern parts of the valley. Consequently, they get about 30 to 40 percent more precipitation in a year than Kalispell. Precipitation data compiled from United States Weather Bureau records for Kalispell are shown in tables 1 and 2.

Low precipitation in July and August limits the yield of spring wheat. Winter wheat, having a more extensive root system and an earlier maturing date, is generally regarded as a more dependable crop.

Temperature

In winter, the valley is shielded by mountain barriers from the cold waves that sweep over the plains east of the Continental Divide. Sometimes, however, enough cold air builds up over the Canadian prairie provinces to spill over the mountain divides. When this occurs, cold air rushes into Flathead Valley through Bad Rock Gap near Columbia Falls. The blast of cold air is commonly accompanied by north-northeast winds having an average velocity of 50 to 60 miles per hour. By the time the spreading cold air has reached the southwestern corner of the valley, its direction has changed to the northwest. During the cold wave, wind velocities are fairly light in the northwestern part of the valley around Whitefish and in the southeastern part near Flathead Lake.

TABLE 1.—*Precipitation in Kalispell, Mont.*

Month	Precipitation					Snow
	Average [1]	Maximum		Minimum		Average depth [2]
	Inches	*Inches*	*Year*	*Inches*	*Year*	*Inches*
January	1.57	3.40	1943	0.27	1944	12.0
February	1.11	2.13	1940	.06	1934	9.0
March	.95	3.12	1898	.20	1926	6.5
April	.80	1.92	1948	.01	1924	1.7
May	1.46	4.50	1902	.34	1897	.3
June	2.06	4.56	1947	.40	1910	.2
July	1.10	3.15	1948	.09	1917	0
August	.87	3.28	1947	.01	1931	0
September	1.24	3.02	1900	.04	1928	.1
October	1.06	3.40	1914	(3)	1907	1.2
November	1.35	5.17	1897	.17	1929	8.0
December	1.45	4.78	1917	.26	1897	10.4
Annual	15.02	20.91	1948	10.39	1929	49.4

[1] Average for a 52-year period, beginning 1897.
[2] Average for a 50-year period, beginning 1897.
[3] Trace.

Additional moderating influences on winter temperatures are Flathead Lake, Flathead River, and the smaller lakes and streams in the valley. Flathead Lake is about 30 miles long and seldom freezes over. Some of the smaller lakes and streams do not freeze until late in winter.

The minimum January temperatures in Havre, Kalispell, and Spokane during the period 1930 to 1939 are shown in figure 5.

Temperature data from United States Weather Bureau records for Kalispell are given in table 3. In addition, an average of 7 days a year have maximum temperatures above 90 degrees, and 12 days have minimum temperatures below zero. Temperatures of 100 degrees or above have been recorded only twice in Kalispell.

Maximum and minimum daily temperatures, by months, and the range in daily temperatures at Spokane, Kalispell, and Havre are given in figure 6.

The maximum and minimum temperature curves for Kalispell, Mont., and Spokane, Wash., are almost parallel; the latter is about 5 degrees lower. The wide variation of temperature throughout the year at Havre, Mont., is very striking, as is the range in daily temperature, compared to that of the other two stations.

Growing season

The average length of the growing season is 150 days at Kalispell and 99 days at Columbia Falls. At Kali-

TABLE 2.—*Monthly and annual precipitation probabilities at Kalispell, Mont.*[1]

Month	Inches, or less, expected 1 year in—				Inches, or more, expected 1 year in—					
	2	3	5	10	3	4	5	10	20	30
January	1.15	0.95	0.75	0.55	1.40	1.60	1.75	2.10	2.45	2.65
February	.85	.70	.50	.35	1.10	1.25	1.35	1.65	1.95	2.10
March	.90	.65	.45	.30	1.15	1.30	1.45	1.80	2.15	2.35
April	.80	.65	.50	.40	1.00	1.15	1.20	1.50	1.75	1.90
May	1.40	1.00	.70	.40	1.85	2.15	2.35	3.00	3.60	3.95
June	1.90	1.50	1.15	.85	2.30	2.60	2.80	3.45	4.00	4.40
July	.95	.65	.40	.20	1.25	1.45	1.60	2.05	2.50	2.75
August	.85	.60	.35	.15	1.15	1.35	1.50	1.95	2.40	2.65
September	1.10	.80	.55	.31	1.45	1.70	1.85	2.35	2.85	3.10
October	.90	.65	.40	.20	1.25	1.45	1.60	2.05	2.50	2.75
November	1.30	.95	.70	.40	1.70	1.95	2.10	2.65	3.20	3.50
December	1.10	.80	.60	.35	1.45	1.70	1.85	2.35	2.80	3.05
Annual	14.25	13.20	12.35	11.60	15.50	16.25	16.80	18.50	20.15	21.05

[1] Based on 1897–1949 records. Example: In January, 1 year in 5 is expected to have 0.75 inches, or less, of precipitation and 1 year in 10 is expected to have 2.10 inches, or more.

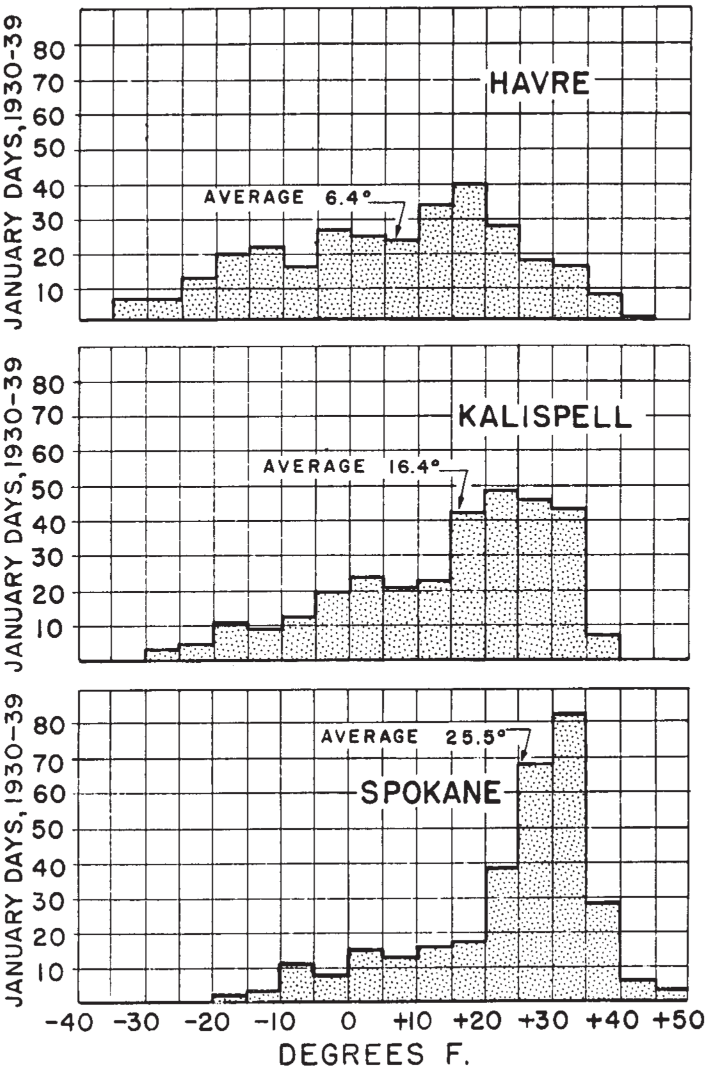

Figure 5.—Distribution of daily minimum temperatures during January days at Havre, Mont., Kalispell, Mont., and Spokane, Wash., in 10-year period, 1930–39.

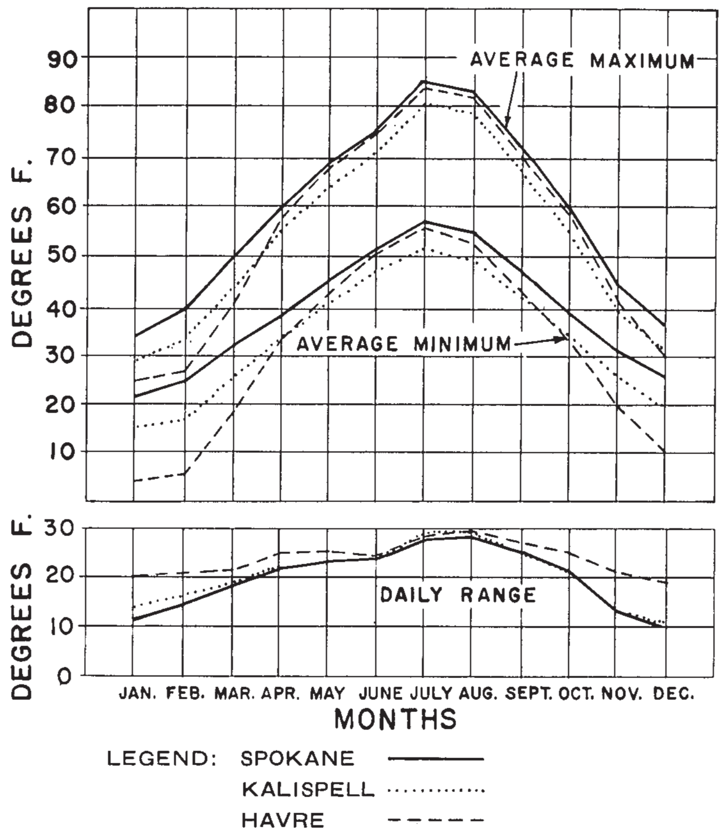

Figure 6.—Upper: Average maximum and average minimum daily temperatures by months at Spokane, Wash., Kalispell, Mont., and Havre, Mont. Lower: Average daily range in temperatures at the same places.

spell, the average date of the last killing frost in spring is May 4 and the first in fall is October 1. In Columbia Falls the last killing frost is June 1 and the first in fall is September 8.

No doubt the valley has cold spots where the growing season is less than 90 days. Cold air drains from valley sides into low places. Timber and minor topographical features tend to act as cold air dams and greatly complicate the frost pattern. The shortest growing season is along the eastern fringe of the valley.

For planning agricultural activities, such as planting dates for various crops, it is often necessary to know when different temperatures might occur in the spring and fall. Figure 7 shows the probability of receiving temperatures of 16, 24, and 32 degrees during the spring and fall months. The left side of the chart shows that on April 20 the temperature will be 24 degrees or less in 15 percent of the years at Kalispell.

Table 3.—*Average maximum and minimum temperatures by months and the highest and lowest temperatures recorded in Kalispell*

Month	Average [1]		Highest		Lowest	
	Maximum	Minimum				
	°F.	°F.	°F.	Year	°F.	Year
January	28. 7	15. 0	56	1934	−34	1909
February	32. 8	16. 7	62	1932	−31	1933
March	42. 8	24. 6	68	1899	−16	1898
April	55. 0	33. 0	85	1936	−8	1936
May	63. 7	40. 4	95	1936	17	1899
June	70. 3	46. 6	95	1918	31	1901
July	80. 1	51. 1	101	1934	35	1902
August	78. 1	48. 8	98	1926	30	1910
September	66. 6	41. 5	91	1938	7	1926
October	54. 8	33. 8	80	1942	−4	1935
November	39. 2	25. 7	65	1908	−12	1921
December	30. 8	19. 0	58	1918	−27	1924

[1] Average for a 52-year period, through 1949.

Wind

The prevailing direction and average velocity of wind in miles per hour at Kalispell are:

Month	*Direction*	*Velocity*
January	Northwest	5. 2
February	West	5. 4
March	West	6. 2
April	West	6. 8
May	West	6. 7
June	West	6. 4
July	West	6. 4
August	West	6. 2
September	West	6. 0
October	Northwest	5. 5
November	Northwest	5. 1
December	Northwest	5. 1

Because of local influence, conditions at Kalispell are not representative of the entire valley. The prevailing wind direction for the year is from the west at Kalispell. It is from the south at the Flathead County Airport about 8 miles north-northeast from Kalispell. Winds are considerably stronger at the airport. Warm air formed over land in the afternoon is displaced by cool air from the lake at night. Differential heating of air between Flathead Lake and the valley causes southerly winds in the afternoon from March to September. The highest velocity ever recorded for wind in Kalispell was 39 miles per hour in June 1931. Much stronger wind than this occurs in winter in the northeastern part of the valley.

General Soil Map

As we study or map the soils of the Upper Flathead Valley Area, it is fairly easy to see differences as one travels from place to place. There are many obvious differences in the shape, length, depth, and speed of streams; in the width of bordering valleys; in the kinds of plants; and in the agriculture. Less noticeable are the differences in the pattern of soils.

By drawing lines around the different patterns of soils on a small map, one may obtain a map of the general soil area, or, as they are sometimes called, soil associations. Such a map is useful to those who want only a general idea of the soils, who want to compare different parts of the Upper Flathead Valley Area, or who want to locate large areas suitable for some particular kind of agriculture or other broad use. The colored general soil map in the back of this report shows 14 soil associations in the Upper Flathead Valley Area. A discussion of each soil association follows.

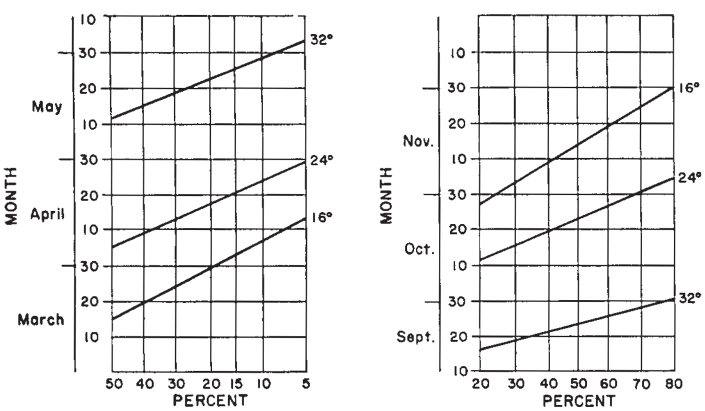

Figure 7.—Probability of occurrence of 16, 24, and 32 degree temperatures at Kalispell in spring and fall. Left: Percentage of years that temperatures will occur on a given date in spring. Right: Percentage of years that temperatures will occur on a given date in fall.

Whitefish association

The largest part of this association is in the northwestern part of the Upper Flathead Valley Area. Smaller parts are mainly around the edges of the valley where the land rises to the mountains. Most of the slopes in this association range from moderate to very steep. Some small areas are nearly level.

The Whitefish soils cover most of this association. They are deep, well-drained, light-gray, loamy soils that have developed in till under a heavy forest cover.

Most of this association is in second-growth forest. Some small areas have been cleared and are farmed. Other clearings are used for growing Christmas trees.

Waits association

This association is in the southeastern part of the Upper Flathead Valley Area. It contains level to gently sloping foot slopes that grade eastward to the mountains.

This association consists mostly of Waits soils but has small areas of Krause soils. Waits soils are deep, well-drained, pale-brown, mostly cobbly and stony loams that have developed in till and outwash material, under a heavy forest cover.

Most of this association is in second-growth timber. A few acres are used for the production of Christmas trees. The smoother areas have been cleared and are used mainly for pasture and hay. Most farms in this association are small and have only enough cleared land for pasture and hay for a few cows and for a garden and fruit trees. Farm income is supplemented by part-time work in the lumber industry.

Krause association

This association is in the southeastern part of the Upper Flathead Valley Area. It is a rough area with steep slopes but contains a few small spots of more level land. Small kettle-hole lakes, of which Echo Lake is the largest, are scattered throughout this association.

In this association are moderately deep, stony and gravelly, pale-brown, loamy soils that have developed in till and outwash material under a heavy forest cover. These soils are moderately to excessively drained. The subsoils are moderately coarse to coarse. The Krause soils cover most of the area, but small acreages of the Waits soils also occur.

This association is mainly in second-growth forest; very little of it has been cleared.

Selle-McCaffery association

This association is in the southeastern part of the Upper Flathead Valley Area. The topography is gently rolling; slopes range from nearly level to moderately steep.

This association consists of deep, excessively drained, pale-brown, sandy soils that have developed in sandy outwash material under a heavy forest. The Selle and McCaffery soils cover most of the area.

Most of the trees have been cleared. Grasses have been planted for pasture and hay. Small grain and berries are also grown.

Half Moon-Depew-Stryker association

Most of this association is in the northern part of the Upper Flathead Valley Area. Small acreages of it are scattered in the eastern part. This association has nearly level to gentle slopes. Some low areas are along the streams.

The soils in this association are deep, light-gray, and loamy to somewhat clayey. They have developed in alluvial material under a heavy forest. They range from well drained to poorly drained. The Half Moon and Depew soils occur on higher, well-drained sites; Stryker soils are on the low, moderately well drained sites, and the Radnor soils are on poorly drained sites. These alluvial soils are along the main streams that flow through this association.

A high percentage of this association has been cleared and is used for crops. More is being cleared each year. The main crops are small grain, alfalfa, and tame hay.

Creston-Flathead-Blanchard association

This association occurs in the eastern part of the Upper Flathead Valley Area. The topography is nearly level to gently sloping.

The soils of this association are deep, well drained, nearly black, and loamy and moderately sandy. They have developed in outwash and terrace alluvium under a heavy cover of grass. The Creston and Flathead soils are on the more nearly level areas; Blanchard and Yeoman soils are on low knolls, which are wooded in places (fig. 8).

Most of this association is cultivated. Some woods and grassland are on the more sandy knolls. The main crops are small grain and hay. Potatoes, peas, and specialty crops are also grown.

Mires-Blanchard association

This association is in the eastern part of the Upper Flathead Valley Area. Relief ranges from nearly level to gently rolling.

In this association are deep, nearly black sandy soils and shallow, gravelly soils that have developed in outwash and terrace alluvium under a dense cover of grass. Thin stands and patches of ponderosa pine grew in some parts. Drainage is moderate to excessive.

The Mires soils are on the more nearly level areas, and the Blanchard soils are on the sandy hummocks and knolls. Included with these soils are smaller acreages of Flathead and Yeoman soils.

About 75 percent of this association is cultivated, and the rest is in pasture and forest. The main crops are small grain and hay. Peas are grown on these soils in the southern part of the valley.

Kalispell-Tally, Blanchard, and Flathead association

This association occurs in the west-central part of the Upper Flathead Valley Area. Relief is mostly nearly level to gently rolling, but some small areas are steeper.

This association consists of deep, dark-brown, well-drained, loamy and moderately sandy soils and moderately deep, gravelly soils. These soils have developed in outwash and terrace alluvium under a moderate to heavy cover of grass. The Kalispell, Tally, Blanchard, and Flathead soils are in the more nearly level areas; some Kalispell soils are on the steeper slopes. Blanchard soils are on small dunes or knolls. Also in this association are Prospect soils on rolling terrain and Yeoman soils on the smoother spots composed of glacial material. The association also includes some Saline-alkali land.

The soils in this association are cultivated. The main crops are small grain and hay, including alfalfa. Most farms have a small pasture for livestock.

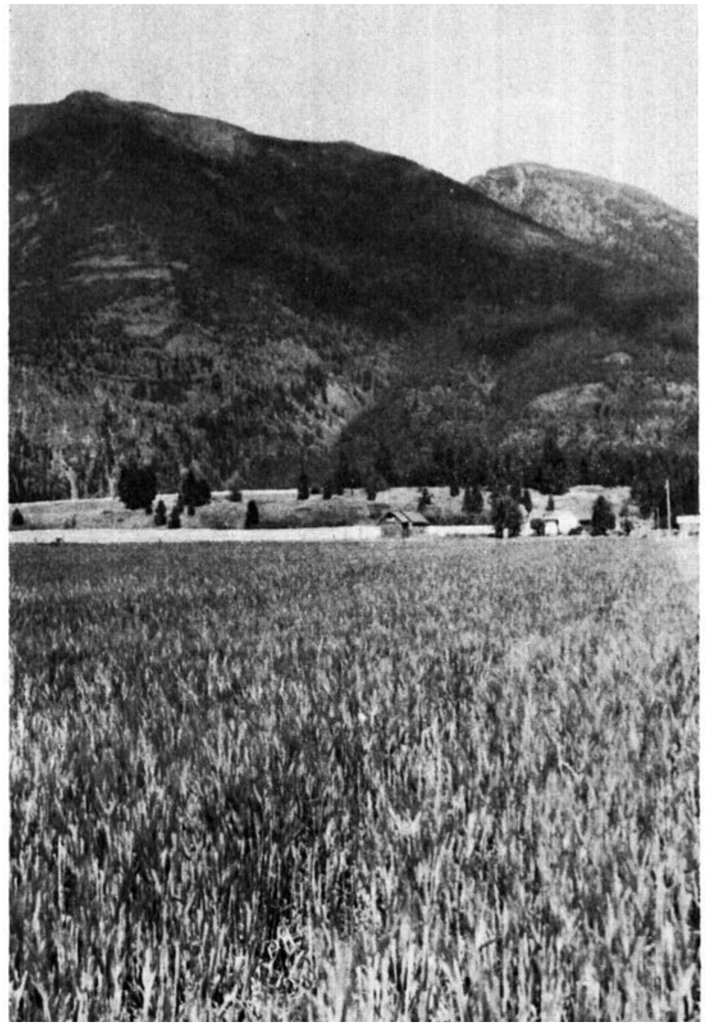

Figure 8.—Barley growing on Creston silt loam. Blanchard fine sand is on the low hill, and Mountainous land is in the background.

Kalispell-Somers-Demers association

This association is in the south-central part of the Upper Flathead Valley Area. The topography is nearly level to gently sloping. In places there are small, curved, intermittent drainageways that were formed by stream overflow. Alkali spots are apparent in some of the fields.

In this association are mostly deep, dark-brown, well drained and moderately well drained, loamy to clayey soils. These soils have developed in terrace alluvium under a moderate to heavy cover of grass. The Kalispell soils are in well-drained sites; the Somers soils in moderately well drained sites. The Demers soils are on low

ridges and have numerous slick spots. This association also includes some Saline-alkali land.

All of this association except the low wet spots and alkali areas is cultivated. The main crops are small grain, potatoes, peas, and mixed-grass hay.

Kiwanis-Walters-Birch association

This association is mainly in the central part of the Upper Flathead Valley Area. The area in which it occurs is a nearly level, low terrace, mainly between the Whitefish and Flathead Rivers. A few low spots occur within the area.

This association consists of deep to shallow, gray and dark grayish-brown, loamy to moderately sandy soils. These soils have developed in low-terrace stream alluvium, under trees and grass. They are well drained to excessively drained. Kiwanis, Walters, and Birch are the principal soils.

About half of this association has been cleared for cultivation or pasture, and more is being cleared each year. The main crops are small grain, hay, and pasture. Peas are also grown.

Swims association

This association is in the south-central part of the Upper Flathead Valley Area. It occurs in a nearly level area that contains some old channels of the Flathead River.

Figure 9.—**Wheat growing on Swims silt loam. Mountainous land is in the background.**

This association is made up of deep, gray, moderately well drained, loamy to clayey soils that have developed in low-terrace stream alluvium, under a cover that was mainly forest. The Swims are the main soils in the association (fig. 9), but the Chamokane soils are on some of the lower areas that are still in timber. Alluvial land, well drained, and Alluvial land, poorly drained, are along the river.

Most of this association has been cleared and is in cultivation. The main crop is small grain; mixed-grass hay is also produced.

Prospect-Yeoman, moderately deep over sand, association

This association is in the western part of the Upper Flathead Valley Area. The topography is gently sloping to rolling (fig. 10). When the land was cleared for cultivation, the many boulders that covered it were removed and piled in fields, or used for rock fences.

This association consists mainly of deep, dark-brown and nearly black, well-drained, stony loamy soils that developed in till under a moderate to heavy cover of grass. The Yeoman soils are moderately deep over sand and occupy gentle slopes. The Prospect soils occur on stronger slopes.

Most of this soil is in cultivation, mainly for small grains. The rest is in pasture.

Banks-Chamokane-Corvallis association

This association is mainly along the Flathead River. The topography varies. Slopes are usually nearly level to gently sloping, but there are many low, wet spots.

This association consists of deep, gray and grayish-brown, loamy soils and deep, sandy soils with sandy subsoils. These soils have developed in recent stream alluvium and under a cover of brush and trees. Soil drainage ranges from excessive to poor. In addition to the Banks, Chamokane, and Corvallis soils, this association

Figure 10.—**Characteristic topography of the Prospect-Yeoman, moderately deep over sand, association. Yeoman soils are on the gentle slopes. Prospect soils are on the steeper slopes and the wooded hill. The timbered mountains in the background are Mountainous land.**

also contains Muck and Peat and some Alluvial land, poorly drained.

Only about 25 percent of this association is cultivated. The rest is in pasture and in forest of mixed trees.

Half Moon-Haskill association

This association is in the southeastern part of the Upper Flathead Valley Area. It consists of nearly level to dunelike, kame-and-kettle areas.

The soils in this association are deep, light gray to brown, and loamy to sandy. They have developed in terrace and outwash alluvium under a cover of trees. They are well drained to excessively drained. The Half Moon soils are in more nearly level sites, and the Haskill soils are on the stronger slopes.

About 75 percent of this association has been cleared and is used mainly for small grain and pasture. The rest is in timber.

Use and Management of Soils

Farming in the Upper Flathead Valley Area consists mainly of growing feed, pasturing livestock, and producing small grain, fruit, vegetable, and other cash crops for market and home use. The management of cropland, irrigated land, and pasture is discussed in this section. In addition, the soils of Upper Flathead Valley Area are grouped into capability classes, subclasses, and units, and the use and management of each capability unit are discussed. Finally, the average yields of principal crops obtained under ordinary management and those obtained under improved management are given in table 4.

Management of Cropland

When cultivating soils in the Upper Flathead Valley Area, it is necessary to conserve moisture, control erosion, maintain fertility and organic matter, and improve the tilth. Most good farming practices accomplish more than one purpose and can be used on most of the cropland in the valley. A discussion of several farming practices that are beneficial to soils in the Upper Flathead Valley Area follows.

Fallowing

Land in fallow, or free of crops and weeds for some time, accumulates moisture and nitrates that can be used by the next crop. To eliminate vegetation, the land is plowed or worked about the time the weeds or volunteer wheat start to grow. A blade or sweep-type implement is best for tilling fallow land because it leaves crop residue on the surface to protect the soil from wind erosion and to keep it porous so it can absorb moisture. Sweeps that are 24 inches or more in width are the best.

Fallow land without sufficient cover is exposed to wind and water erosion and may require emergency tillage. Implements that roughen the soil surface and, where possible, bring up subsurface clods are most effective.

Improving soil structure

Productivity of cultivated land in the Upper Flathead Valley Area can be maintained or improved by practices that favor tilth and good soil structure. The natural structure of the better agricultural soils is very good for plant growth. However, productivity is reduced if the crumb and granular structure in the surface soil is destroyed.

When the soil has been tilled for a long time and not enough crop residue is left on the surface, the original crumb or granular structure breaks into fine particles or single grains. In this condition, the soil is subject to wind and water erosion. The pores and channels for entrance of air and water tend to close, and the soil becomes caked.

Continuous tillage, at the same depth, causes in some loamy and sandy loam soils a compact, dense and hard plowsole from 1½ to 3 inches thick. The plowsole retards the movement of water and the growth of plant roots. Tillage at different depths each season will break a plowsole or help prevent its formation.

Implements used for cultivation and preparation of seedbeds should disturb the natural soil structure as little as possible. They should partly turn under the sod or stubble and leave clods on the roughened surface to prevent wind erosion. This practice is called stubble-mulch tillage. Tilth of many soils can be improved by stubble-mulch tillage, or by planting them to perennial grasses.

The tilth of Depew silty clay loam and other heavy soils is improved by fall plowing because freezing and thawing slake, or soften, the hard clods. Fall plowing is hazardous on some soils, however, because they are subject to wind erosion. In general, the heavy soils are less subject to wind erosion than the loams and sandy loams, which have a very weak crumb or single-grain structure and are easily moved by wind.

The productivity of claypan soils is improved by tillage. This is brought about by the slow breaking up of the claypan and by spreading over the pan spots, soil from the areas that have a more loamy surface. Straw and manure also help to improve the structure of slick spots.

The most beneficial practices are those that allow the most water to enter the soil and encourage the maximum development of plant roots. The roots of a single plant, such as wheat, can be very long.

Controlling erosion

The basic practices that help control erosion consist of maintaining good soil structure, protecting the surface with a stubble mulch, planting steep, erodible slopes to permanent vegetation, and keeping a good stand of grass in pastures.

Stubble-mulch tillage should be used on most cultivated soils. Crop residues furnish nitrogen and organic matter to the soil and help prevent erosion. They also promote good tilth and structure that keeps the surface soil porous.

Blanchard fine sand, Kalispell loam, and other similar soils are particularly subject to wind erosion. Intensive stubble-mulch tillage and the use of all available crop residue are needed to control erosion. Some of the narrow ridges require seeding to grass to check soil erosion and to prevent damage to nearby areas.

Steep areas not suitable for tillage, or areas suitable for only limited or occasional cultivation, are often intermingled with the better soils. How these areas are used is determined by their size and by the predominant type

of soil. Extensive acreages of steep or thin soils should be kept permanently in grass. Cropping systems that keep the soil in continuous cover will help prevent erosion. On some soils stripcropping will be beneficial.

Sod, or grassed, waterways should be established where water concentrates. They are beneficial even where contour cultivation is not practical. When land is cleared, the vegetation in waterways should not be disturbed, as it prevents water erosion.

Clearing

Some soils now in cutover or second-growth forests are suitable for farming. Modern equipment has made it practical to clear some areas of these soils. Those areas that have been cleared and farmed are generally light colored, acid, and somewhat low in fertility and organic matter. They need some improvement before they will produce good yields.

When land is cleared, the large trees are usually harvested for lumber or other wood products. The remaining trees and shrubs are then cut, piled, and burned, but the stumps interfere with cultivation (fig. 11). Where dense stands of small lodgepole pine are cleared, the stumps are usually bulldozed out with the trees.

After the trees have been removed, Dutch and alsike clover, timothy, fescue, and Kentucky and Canada bluegrasses become established naturally. Additional seeding may be needed to increase the stand. Quackgrass invades areas that get more moisture, and it may be cut for hay.

Agricultural lime is generally applied to newly cleared land. Nitrogen and phosphate fertilizer may also be applied to improve the fertility. Crops can be grown 1 or 2 years earlier in fertilized areas.

Figure 11.—Cleared area of Depew silty clay loam along the Stillwater River. In the foreground, stumps have been removed and the soil plowed. A dense stand of second-growth lodgepole pine is in the background. In the middle ground, pine has been bulldozed out and burned, but some stumps have been left. Grass is established in this area.

After the clovers and grasses have become established, the cleared area may be used for pasture for several years, or until the operator finds time to remove the stumps. Stumps are removed by pulling or by grubbing, depending on their size and number and the time available. After the removal of stumps, rocks should be removed and the land smoothed and plowed. In recent years, the development of better equipment allows clearing in one operation.

Barley is usually seeded first on cleared land, and it is followed by other crops. Limestone and fertilizer are used, as necessary, to maintain good yields. Some areas are cleared and planted to grass for pasture.

Management of Irrigated Land

Only a small percentage of the Upper Flathead Valley Area is irrigated. About 4,000 acres northwest of Kalispell are irrigated from the Ashley Ditch, and about 1,000 acres in scattered tracts are irrigated from private ditches. These small irrigation systems obtain water from mountain streams that flow into the valley. Soils and irregular topography limit the area than can be irrigated from ditch systems. About 12,000 acres are being irrigated by sprinkler systems. Water for sprinkler irrigation is pumped from rivers, streams, kettle holes, dugouts, pits, ditches, and wells and is piped under pressure to field sprinklers.

Crops respond well to irrigation if adequate fertilizer and organic matter are used. Most potatoes grown in the valley are irrigated. Technical help in irrigation can be obtained from the county agent or the Soil Conservation Service.

Management of Range and Pasture

Most of the pasture and rangeland in the Upper Flathead Valley Area is in small areas and is used for a few head of livestock on small farms. Most of the soils that have developed under grass are now cultivated, except small areas on steep slopes or very stony areas. Many of the pastures are in brushy, cutover forest and in small clearings. These areas contain Dutch and alsike clover, timothy and Kentucky and Canada bluegrasses, and several of the fescues. The forage available from brushy pastures depends on the density of trees and brush and the percentage of open area.

Where forage is needed for dairy cattle or other livestock, grassland has been reseeded and brushy pasture improved by cutting brush and trees. Some tame pasture is irrigated in dry weather to supplement the forage from the dryland pastures. Help in pasture management is available from the county agent and the Soil Conservation Service.

Capability Groups of Soils

The capability grouping is an arrangement used to show relative suitability of soils for tilled crops, hay, pasture, forestry, or wildlife and to show the difficulties or risks in using them. It is widely used in helping

farmers plan the proper use of land and the practices for conserving soil and moisture.

Eight broad classes, identified by roman numerals, are provided in the capability classification. All soils in one class have limitations and management problems of about the same degree, but they are of different kinds as shown by the subclass. Soils are placed in classes after joint study by a number of persons who have knowledge of the soils and agriculture of an area.

Class I soils are easy to farm and have no serious limitations for use. Such soils are subject to only slight erosion, drought, wetness, or other limitations and are at least fairly fertile. They are good for many uses. A farmer can use his class I soil for crops without special practices, other than those needed for good farming anywhere, and can choose one of several cropping patterns. If he wishes, he may use the soil for pasture, trees, or other purposes.

Class II soils can be cultivated regularly, but they do not have quite so wide a range of suitability as class I soils. For example, a fertile, easily tilled soil may have moderate limitations because of wetness and may need artificial drainage for good crop production. Other soils may be placed in class II because they have a moderate erosion hazard or are too droughty to be in class I.

Class III soils are suitable for regular cropping and have a narrower range of use and more stringent management requirements than those in class II.

Class IV soils should be cultivated only occasionally or only under very careful management.

Soils generally not suitable for cultivation, or on which cultivation is not advisable, are in classes V, VI, VII, or VIII. They can be used for pasture or range, as woodland, or for wildlife.

Class V soils are not subject to erosion, but they are unsuited to cultivation because of stoniness, standing water, or frequency of overflow.

Class VI soils are steep, droughty, stony, or shallow but will produce fairly good amounts of forage, orchard crops, or forest products. As a rule, class VI soils should not be cultivated, but some can safely be disturbed enough to prepare them for planting trees or seeding pastures.

Class VII soils are more limited for use than those in class VI, require more care in handling, and usually produce only fair to poor yields of forage but may produce good yields of wood products.

Class VIII soils have practically no agricultural use. They are so severely limited that they produce little useful vegetation. They may have some value as watersheds, wildlife habitats, or recreation areas.

Divisions of the broader groupings, the subclasses, are used to indicate the dominant kind of limitation. The letter symbol "e" means the main limiting factor is risk of erosion if the plant cover is not maintained; "w" means that excess water retards plant growth or interferes with cultivation; and "s" means that the soils are shallow, droughty, stony, unusually low in fertility, or have a low capacity to hold moisture; "c" means unfavorable climate. All classes except class I may have one or more subclasses.

The capability classes, subclasses, and units in the Upper Flathead Valley Area are given in the following list.

Class I.—Soils that have few limitations in use.
- I-1: Deep, dark-colored, well-drained, loamy, nearly level soils with loamy to slightly clayey subsoils.

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe: Soils subject to slight or moderate wind and water erosion.
  - IIe-1: Deep, dark-colored, well-drained, silty or moderately sandy, nearly level or gently sloping soils.
  - IIe-2: Deep, dark-brown, well-drained, loamy to moderately sandy, nearly level or gently sloping soils.
  - IIes-1: Deep, dark-colored, sandy, nearly level or gently sloping soils.
- Subclass IIs: Soils that are slightly or moderately fertile, have a slight to moderate capacity to hold moisture, and are subject to slight or moderate wind erosion.
  - IIs-1: Moderately deep, light-colored, well-drained, silty or loamy, nearly level or gently sloping soils.
- Subclass IIw: Soils that are moderately limited by excess water.
  - IIw-1: Moderately deep, dark-colored, silty, nearly level or gently sloping soils that have a high water table part of the time.

Class III.—Soils that have severe limitations that reduce the choice of plants or require special conservation practices, or both.
- Subclass IIIe: Soils subject to moderate or moderately severe erosion.
  - IIIe-1: Moderately deep or deep, dark-colored, loamy, moderately sloping or gently rolling soils.
  - IIIe-2: Moderately deep, light-colored, well-drained, loamy, moderately sloping or gently rolling soils.
- Subclass IIIs: Soils that have severe limitations, chiefly because of water-holding capacity, soil texture, or salts.
  - IIIs-1: Moderately deep, dark-colored, loamy, nearly level or gently sloping soils that are underlain by sand and gravel.
  - IIIs-2: Deep, light-colored, well-drained, loamy, nearly level or gently sloping soils.
  - IIIs-3: Deep, light-colored, moderately well drained, clayey, nearly level or gently sloping soils.
  - IIIs-4: Deep and moderately deep, silty and clayey, nearly level to rolling complexes that contain saline and alkaline soils.
- Subclass IIIw: Soils limited by seasonal excess water.
  - IIIw-1: Moderately deep, moderately wet, silty, nearly level soils.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.
- Subclass IVe: Soils subject to moderately severe erosion.

IVe–1: Moderately deep to deep, dark-colored, loamy, gently rolling to steep soils.
IVes–1: Shallow to moderately deep, dark-colored, sandy, nearly level or gently sloping soils.

Subclass IVs: Soils that have very severe limitations, mainly because of water-holding capacity, soil texture, shallowness, or salts.

IVs–1: Shallow to moderately deep, dark-colored, loamy, nearly level to gently rolling soils that are underlain by sand and gravel.
IVs–2: Deep, moderately well drained, light-colored, clayey, nearly level soils.
IVs–3: Deep and moderately deep, light-colored, sandy, nearly level to rolling soils.
IVs–4: Shallow and moderately deep, loamy to silty, nearly level or gently sloping soils that are underlain by coarse material.

Class V.—Soils that have little or no erosion hazard but have other limitations that are impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Subclass Vs: Stony soils.

Vs–1: Stony, nearly level or gently sloping soils.

Subclass Vw: Wet soils.

Vw–1: Poorly drained soils.

Class VI.—Soils having severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe: Soils subject to severe erosion.

VIe–1: Stony or coarse-textured, rolling to very steep soils.
VIes–1: Deep, excessively drained, very sandy, rolling to very steep soils.

Subclass VIs: Soils with severe limitations caused by stoniness, moisture-holding capacity, or salts.

VIs–1: Mixed alluvial soils that are subject to flooding, droughtiness, and seasonal high water table.
VIs–2: Deep, loamy, nearly level to steep soils that are moderately saline, saline, and strongly alkaline.

Class VII.—Soils having very severe limitations that make them unsuited for cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIs: Soils with very severe limitations caused mainly by shallowness, stoniness, moisture-holding capacity, or salts.

VIIs–1: Shallow and stony, moderately steep to very steep soils.

Class VIII.—Soils having limitations that prevent their use for commercial plant production and restrict their use to recreation, wildlife, water supply, or aesthetic purposes.

Subclass VIIIs: Sands and gravels.

VIIIs–1: Coarse sand and gravel that is flooded part of the time and has little or no vegetative cover.

Description of capability units

In this section each capability unit is described and the soils in it are listed. In addition, suggestions are given on how to use and manage the soils in each unit.

CAPABILITY UNIT I–1

Deep, dark-colored, well-drained, loamy, nearly level soils with loamy to slightly clayey subsoils

Creston silt loam, 0 to 3 percent slopes.
Flathead very fine sandy loam, 0 to 3 percent slopes.
Somers silt loam, 0 to 3 percent slopes.

These are the most desirable soils for crops in the Upper Flathead Valley Area. They are easily tilled and moderate to high in fertility, and they will hold a good supply of moisture for plants. Water erosion is not a problem, but some wind erosion may occur if the soils are bare for long periods. Water accumulates for a short time in the low places after heavy rains or rapid melting of snow.

All crops suited to the Area are grown on these soils, but winter wheat is the principal crop.

A 4-year cropping system is commonly used on these soils. Small grain, peas, or potatoes are grown for 2 years. In the third year, wheat is grown with sweetclover. The sweetclover is plowed under in midsummer of the fourth year, and the land is summer fallowed to kill weeds. Winter wheat is seeded in the fall. When alfalfa is grown, the stand is allowed to remain for several years if the yield of hay is satisfactory.

Crop yields can be maintained at a fairly high level if a green-manure crop is plowed under in the 4-year rotation. Some farmers use nitrogen and phosphate fertilizer on peas and potatoes and have obtained greatly increased yields from these crops in years of good moisture. Fertilizer should be applied according to soil tests and crop needs.

These soils are well suited to irrigation, especially if used for alfalfa, potatoes, and peas. Yields of these crops can be improved if proper quantities of fertilizer and large amounts of organic matter are applied to the soils.

CAPABILITY UNIT IIe–1

Deep, dark-colored, well-drained, silty or moderately sandy, nearly level or gently sloping soils

Creston silt loam, 3 to 7 percent slopes.
Flathead very fine sandy loam, 3 to 7 percent slopes.
Somers silt loam, 3 to 7 percent slopes.
Yeoman gravelly loam, 0 to 7 percent slopes.
Yeoman silt loam, 0 to 7 percent slopes.

These soils are easily tilled, are moderate to high in fertility, and can hold a good supply of moisture for crops. In addition, the hazard of water erosion is moderate and that of wind erosion is slight. Because of the gentle slopes, some water is lost as runoff.

All crops are suited to these soils, except that potatoes are not grown on the Yeoman gravelly loam. The 4-year cropping system described for soils in capability unit I–1 is suitable for these soils.

Fertilizer and green-manure crops should be used to maintain fertility and organic matter in the soils. Stubble mulch tillage retards runoff and helps prevent erosion.

These soils are well suited to irrigation, and some small areas are now irrigated. Water is obtained from

kettle holes and streams. High yields of irrigated crops are obtained if ample supplies of organic matter and plant nutrients are in the soil.

CAPABILITY UNIT IIe-2

Deep, dark-brown, well-drained, loamy to moderately sandy, nearly level or gently sloping soils

Chamokane soils, 0 to 3 percent slopes.
Chamokane soils, 3 to 7 percent slopes.
Kalispell loam, 0 to 3 percent slopes.
Kalispell loam, 3 to 7 percent slopes.
Kalispell loam, moderately deep over sand, 0 to 3 percent slopes.
Kalispell loam, moderately deep over sand, 3 to 7 percent slopes.
Kalispell loam, 0 to 3 percent slopes, wind eroded.
Kalispell loam, 3 to 7 percent slopes, wind eroded.
Kalispell silt loam, heavy subsoil, 0 to 3 percent slopes.
Kalispell silt loam, moderately deep over sand, 0 to 7 percent slopes.
Prospect loam, 0 to 3 percent slopes.
Prospect loam, 3 to 7 percent slopes.
Yeoman loam, moderately deep over sand, 0 to 3 percent slopes.
Yeoman loam, moderately deep over sand, 3 to 7 percent slopes.

These soils are easily tilled and readily permeable to plant roots, air, and moisture. They are moderately well supplied with organic matter and available plant nutrients, but they are moderately droughty. The hazard of wind and water erosion is slight. The two main problems in tilling these soils are conservation of moisture and prevention of erosion.

Because of droughtiness, small grain is the main crop. A commonly used cropping system consists of winter wheat alternated by a year of fallow. After wheat is harvested, the land is plowed or disked and fallowed the next year to conserve moisture. In years when the soil contains ample fall and winter moisture, it is seeded to spring wheat rather than fallowed. Some farmers use a 3-year cropping system consisting of winter wheat, spring wheat, and fallow.

Sweetclover can be spring seeded with the small grain to aid in maintaining organic matter and fertility. After grain is harvested, the clover is allowed to grow the following year until it is large enough for use as green manure. It is then plowed under and the soil fallowed until winter wheat is seeded in fall.

Alfalfa yields are not high on these soils. Normally, the supply of soil moisture is not enough to maintain alfalfa in vigorous growth beyond midsummer.

When the cropping system includes summer fallow, stubble should be kept on the surface to help conserve moisture and control wind erosion. Grassed waterways will also help control water erosion.

These soils are suitable for irrigation, and some of them are irrigated from the Ashley Ditch. Organic matter and fertility should be kept at high levels if the soils are irrigated.

CAPABILITY UNIT IIes-1

Deep, dark-colored, sandy, nearly level or gently sloping soils

Blanchard very fine sandy loam, 0 to 7 percent slopes.
Flathead fine sandy loam, 0 to 3 percent slopes.
Flathead fine sandy loam, 3 to 7 percent slopes.
Flathead sandy loam, 0 to 7 percent slopes.
Flathead-Creston loams, 0 to 3 percent slopes.
Tally, Blanchard, and Flathead soils, 0 to 3 percent slopes.
Tally, Blanchard, and Flathead soils, 3 to 7 percent slopes.
Tally, Blanchard, and Flathead soils, 0 to 3 percent slopes, wind eroded.
Tally, Blanchard, and Flathead soils, 3 to 7 percent slopes, wind eroded.

These soils are easily tilled and readily permeable to roots, air, and moisture. They are moderately fertile and contain moderate supplies of organic matter. The hazard of wind and water erosion is moderate.

The soils are suitable for all crops; potatoes are grown only under irrigation. Cropping systems suitable for these soils are similar to those suggested for soils in capability unit I-1.

Green-manure crops and stubble should be used to maintain a good supply of organic matter in the soils. Fertilizer should be applied according to soil tests and crop needs. Stubble-mulch tillage and wind stripcropping help prevent wind and water erosion. Field windbreaks reduce wind velocity and help prevent erosion.

These soils are suitable for irrigation. Some areas of the Tally, Blanchard, and Flathead soils are irrigated from the Ashley Ditch. Other small fields of these soils are irrigated by sprinklers with water obtained from kettle holes and small streams. Irrigation increases crop yields if the soil is well supplied with organic matter and plant nutrients.

CAPABILITY UNIT IIs-1

Moderately deep, light-colored, well-drained, silty or loamy, nearly level or gently sloping soils

Half Moon silt loam, 0 to 3 percent slopes.
Half Moon very fine sandy loam, 0 to 3 percent slopes.
Waits silt loam, 0 to 7 percent slopes.
Waits silt loam, fans, 0 to 4 percent slopes.
Walters silt loam, 0 to 4 percent slopes.
Walters very fine sandy loam, 0 to 7 percent slopes.
Whitefish silt loam, 0 to 3 percent slopes.

These soils were originally forested, and some of the acreage has been cleared for farming. The hazard of wind and water erosion is slight on these soils.

Yields of crops are poor for several years after clearing because of the low supply of organic matter and nitrogen. They can be improved rapidly by adding fertilizer and organic matter and growing hay and cover crops. After a few years of cultivation, these soils are suitable for all crops grown in the Area. Winter and spring wheat are the main crops. Wheat has highest yields if grown in a cropping system with oats, barley, sweetclover, peas, and tame grasses. Potatoes are not grown on these soils.

In the cropping system, spring-sown small grains usually follow winter wheat, and other crops follow spring-sown small grains. Sweetclover is sometimes seeded in oats, barley, or spring wheat and used as pasture and green manure.

Alfalfa produces well on these soils because of favorable soil moisture. A good stand of alfalfa is sometimes hard to start; but after the plants are established, they thrive and produce well. Better stands of alfalfa are obtained if agricultural limestone is applied.

Stubble and green manure increase the supply of organic matter. Fertilizers should be applied according to soil tests and crop needs. Stubble-mulch tillage protects the soil from wind and water erosion and helps conserve moisture. Stripcropping, where applicable, helps control erosion.

These soils are suitable for irrigation, but only small areas are irrigated.

CAPABILITY UNIT IIw–1

Moderately deep, dark-colored, silty, nearly level or gently sloping soils that have a high water table part of the time

Corvallis silty clay loam, 0 to 3 percent slopes.
Kiwanis loam, 0 to 3 percent slopes.
Somers silty clay, 0 to 4 percent slopes.
Somers silty clay loam, 0 to 3 percent slopes.
Somers silty clay loam, 3 to 8 percent slopes.
Swims silt loam, 0 to 3 percent slopes.
Swims silt loam, 3 to 7 percent slopes.
Swims silty clay loam, 0 to 4 percent slopes.

These soils are affected by a high water table in spring or when water levels are high in the lakes. The soils dry out late in spring because of high water tables, and tillage and spring planting are delayed. However, the extra moisture increases yields of most crops. Grasses produce good hay and pasture.

All crops locally grown are suited to these soils. Small grain, clover, and grass are the principal crops. Clover is grown often enough to maintain the supply of organic matter. Because of the high water table, alfalfa produces well for only about 2 years.

Fertilizer and organic matter should be added according to crop needs.

On some areas, lowering of the water table through drainage improves crop yields. The water table in some of the Somers and Swims soils just north of Flathead Lake is controlled by pumping.

CAPABILITY UNIT IIIe–1

Moderately deep or deep, dark-colored, loamy, moderately sloping or gently rolling soils

Creston silt loam, 7 to 12 percent slopes.
Kalispell loam, 7 to 12 percent slopes.
Kalispell loam, moderately deep over sand, 7 to 12 percent slopes.
Kiwanis loam, 3 to 9 percent slopes.
Prospect loam, 7 to 12 percent slopes.
Tally, Blanchard, and Flathead soils, 7 to 12 percent slopes.
Tally, Blanchard, and Flathead soils, 7 to 12 percent slopes, wind eroded.
Yeoman gravelly loam, 7 to 12 percent slopes.
Yeoman loam, moderately deep over sand, 7 to 12 percent slopes.
Yeoman silt loam, 7 to 12 percent slopes.

These soils are easily tilled and are readily permeable to roots, air, and moisture. They are moderately well supplied with organic matter and available plant nutrients. Because of slopes, the risk of water erosion is moderate on these soils. The risk of wind erosion is also moderate. The mapping units of Tally, Blanchard, and Flathead soils are particularly subject to wind erosion if not protected. Most of the soils in this capability unit are in areas of low rainfall and are slightly droughty.

All local crops can be grown on these soils, but small grains are the main crops. Potatoes are usually not planted, because of the excessive slopes.

In the commonly used cropping system, winter wheat is followed in alternate years by fallow. When fall and winter moisture are good, the soil is seeded to spring wheat rather than fallowed. An alternate cropping system that is suited to these soils consists of winter wheat, spring wheat, and fallow.

Organic matter and fertility can be improved through seeding sweetclover with the spring wheat. The following spring, sweetclover can be plowed under as green manure and the land fallowed until winter wheat is seeded in fall.

Alfalfa yields are not high on these soils. Normally it does not grow vigorously on these soils beyond midsummer, because of the shortage of moisture.

If the cropping system includes summer fallow, stubble-mulch tillage should be practiced to conserve moisture and to help prevent erosion. Drainageways should be grassed. In some areas, stripcropping should be used to save moisture and prevent erosion.

These soils are suitable for irrigation, and some areas are irrigated from the Ashley Ditch. A few smaller areas are irrigated by a spinkler system. Irrigated soils should contain adequate organic matter and plant food.

CAPABILITY UNIT IIIe–2

Moderately deep, light-colored, well-drained, loamy, moderately sloping or gently rolling soils

Half Moon silt loam, 3 to 8 percent slopes.
Half Moon very fine sandy loam, 3 to 7 percent slopes.
Whitefish gravelly silt loam, 0 to 7 percent slopes.
Whitefish gravelly silt loam, 7 to 12 percent slopes.
Whitefish silt loam, 3 to 7 percent slopes.
Whitefish silt loam, 7 to 12 percent slopes.

These soils were originally forested. Some areas have been cleared for farming, and additional land will probably be cultivated. Because of slope, the risk of water erosion is moderate.

Yields of crops are poor for several years after clearing because of the low supply of organic matter and nitrogen. Yields can be improved rapidly by adding organic matter and fertilizer and by growing hay and cover crops. After a few years of cultivation, these soils are suitable for most crops grown in the valley. Winter and spring wheat are the main crops. These crops produce the highest yields when grown in a cropping system with oats, barley, alfalfa, sweet clover, red clover, and tame grasses. Potatoes are not grown on these soils.

In the cropping system, spring-sown small grain usually follows winter wheat and other crops follow the spring-sown small grain. Sweetclover can be seeded in oats, barley, or spring wheat and used as pasture or green manure.

Alfalfa grows well on these soils but is sometimes hard to establish. Applications of agricultural limestone will help to get better stands.

Stubble and green manure increase the organic matter in these soils. Stubble-mulch tillage protects the soils from wind and water erosion and conserves moisture. Since these soils are naturally low in fertility, they are responsive to fertilizer. Fertilizer should be applied according to crop needs and soil tests.

These soils are suitable for irrigation, but only a small acreage is irrigated.

CAPABILITY UNIT IIIs–1

Moderately deep, dark-colored, loamy, nearly level or gently sloping soils that are underlain by sand and gravel

Flathead-Mires loams, 0 to 3 percent slopes.
Kalispell fine sandy loam, moderately deep over sand, 0 to 7 percent slopes.
Kalispell loam, moderately deep over gravel, 0 to 7 percent slopes.
Kiwanis fine sandy loam, 0 to 4 percent slopes.

Mires loam, 0 to 3 percent slopes.
Yeoman cobbly loam, moderately deep over sand, 0 to 3 percent slopes.
Yeoman cobbly loam, moderately deep over sand, 3 to 7 percent slopes.
Yeoman gravelly loam, moderately deep over sand, 0 to 3 percent slopes.
Yeoman gravelly loam, moderately deep over sand, 3 to 7 percent slopes.

These soils are droughty because of the underlying sand and gravel. Bare areas are subject to wind erosion.

Small grain and grasses are best suited to these soils. Winter wheat is better suited than spring wheat because it matures before the arrival of summer dry weather.

These soils should be fallowed to conserve moisture and control weeds. Stubble-mulch tillage will protect the soils from wind erosion. Windbreaks also help prevent wind erosion.

The soils can be irrigated. Yields can be improved through use of a sprinkler system.

CAPABILITY UNIT IIIs-2

Deep, light-colored, well-drained, loamy, nearly level or gently sloping soils

Half Moon-Haskill complex, 0 to 3 percent slopes.
Half Moon-Haskill complex, 3 to 7 percent slopes.
Selle fine sandy loam, 0 to 3 percent slopes.
Selle fine sandy loam, 3 to 8 percent slopes.

These soils were originally forested, but some of the acreage has been cleared for cultivation. The risk of water erosion is slight, and that of wind erosion is moderate.

Yields of crops for several years after clearing are poor because the soils have little organic matter and nitrogen. Yields can be improved rapidly through the addition of organic matter and fertilizer and by growing hay and cover crops. After a few years of cultivation, these soils are suitable for most crops grown in the area. Grasses for hay and pasture and small grains are best suited to these soils. Potatoes are not grown.

Grasses are usually grown in a cropping system with small grains. They are allowed to remain as long as they produce good forage. They are then followed by several years of a small grain.

Good stands of alfalfa may be difficult to establish unless agricultural limestone is applied. After alfalfa is established, it produces well.

Grasses, green-manure crops, and stubble should be used to increase the organic matter. These soils respond well to fertilizer, which should be applied according to crop needs and soil tests.

Stubble-mulch tillage helps to prevent wind and water erosion and to conserve moisture. Field windbreaks also help to prevent wind erosion.

These soils are suitable for irrigation, but, at present, very little is irrigated. Yields can be increased through irrigation if adequate supplies of organic matter and plant food are maintained.

CAPABILITY UNIT IIIs-3

Deep, light-colored, moderately well drained, clayey, nearly level or gently sloping soils

Depew silty clay loam, 0 to 3 percent slopes.
Depew silty clay loam, 3 to 7 percent slopes.

These soils were originally forested, but part of the acreage has been cleared for cultivation. They absorb moisture slowly and can hold large quantities. However, they give it up slowly to growing plants, and, consequently, tend to be slightly droughty in hot summer weather.

Yields of crops for several years after clearing are poor because of the low supply of organic matter and nitrogen. They can be improved by the addition of organic matter and fertilizer.

Small grain, legumes, and grasses are best suited to these soils. Winter wheat is better suited than spring wheat because it can be seeded when the soils are in better condition, and it will mature before the arrival of hot weather.

Alfalfa, sweetclover, and other deep-rooted legumes should be grown for organic matter and to help make the subsoil more permeable. Fertilizer should be applied according to crop needs and soil tests.

These soils are suitable for irrigation, but water should be applied to them slowly. Irrigation improves crop yields if adequate organic matter and plant food are maintained. Irrigation is not now practiced on these soils.

CAPABILITY UNIT IIIs-4

Deep and moderately deep, silty and clayey, nearly level to rolling complexes that contain saline and alkaline soils

Kalispell-Demers silt loams, 0 to 3 percent slopes.
Kalispell-Demers silt loams, 3 to 12 percent slopes.
Kalispell-Tuffit silt loams, 0 to 3 percent slopes.
Kalispell-Tuffit silt loams, 3 to 7 percent slopes.
Prospect-Tuffit silt loams, 0 to 3 percent slopes.
Prospect-Tuffit silt loams, 3 to 7 percent slopes.
Tuffit-Somers silty clay loams, 0 to 5 percent slopes.

The Kalispell, Prospect, and Somers soils in these complexes are well suited to cultivation. The scattered slick spots of Demers and Tuffit soils are difficult to till and reduce yields on the areas as a whole. When these spots are cultivated, some of the heavy clay subsoil is brought to the surface. It forms rough clods that are difficult to work into a suitable seedbed. When moistened by rain, the clods tend to disperse, or slake, into slick spots, which have a hard crust when they dry. Water enters the Tuffit and Demers soils very slowly. Most of it runs off, and there is a slight risk of water erosion. Crops do not develop normally under these conditions.

Winter wheat and grass are best suited to the soils in this capability unit. Alfalfa grows satisfactorily, but stands are difficult to establish on slick spots.

Organic matter should be added, in large amounts, to the clay spots. It improves tilth and the infiltration of water. Barnyard manure reduces crusting and improves fertility of the slick spots. Fertilizer should be applied according to crop needs and soil tests. The removal of excess moisture through the use of interception or surface drains improves slick spots.

These soils are suitable for irrigation only when adequate drainage has been provided.

CAPABILITY UNIT IIIw-1

Moderately deep, moderately wet, silty, nearly level soils

Stryker silt loam, 0 to 3 percent slopes.
Stryker silt loam, sandy subsoil, 0 to 3 percent slopes.
Stryker silty clay loam, 0 to 3 percent slopes.

These soils were originally forested, but some of the acreage has been cleared for cultivation. They are mod-

erately wet. Surface drainage is generally lacking, and some areas may be ponded after heavy rains or rapid melting of snow. Areas adjacent to higher land receive some runoff and seepage. The water table may be within 3 or 4 feet of the surface of these soils part of the time, but it can be controlled through the use of drains.

Yields of crops for a few years after clearing are poor because the soils are rough and have little organic matter and nitrogen. Yields can be improved by the addition of organic matter and fertilizer.

Small grains and grasses are best suited to these soils. Alfalfa will produce satisfactorily in adequately drained areas. Potatoes are not grown on these soils. Grasses and green-manure crops should be grown to increase organic matter. Fertilizers should be applied according to crop needs and soil tests.

Low spots should be filled in to make drainage as uniform as possible. Because they are imperfectly drained, these soils are not irrigated.

CAPABILITY UNIT IVe-1

Moderately deep to deep, dark-colored, loamy, gently rolling to steep soils

Blanchard very fine sandy loam, 7 to 12 percent slopes.
Flathead fine sandy loam, 7 to 20 percent slopes.
Kalispell loam, 12 to 25 percent slopes.
Prospect loam, 12 to 20 percent slopes.
Tally, Blanchard, and Flathead soils, 12 to 20 percent slopes.
Yeoman silt loam, 12 to 20 percent slopes.

These soils are moderately fertile. The risk of wind and water erosion is moderate; consequently, grass or grass-legume mixtures are best suited to these soils. However, in time, the suitable grasses will thin out and be replaced by weeds and undesirable grasses. Before this occurs, small grain should be grown for 1 or 2 years to kill the weeds. Suitable grasses and legumes should then be reseeded in the small-grain stubble. Fertilizer should be applied according to soil tests to increase the vigor and life of the grasses.

When the soils are in small grain, stubble-mulch tillage should be practiced to control wind and water erosion. Pastures should not be overgrazed.

These soils are suitable for sprinkler irrigation. Small areas are now irrigated by this method; the water is obtained from the present system of ditches.

CAPABILITY UNIT IVes-1

Shallow to moderately deep, dark-colored, sandy, nearly level or gently sloping soils

Blanchard fine sand, 0 to 7 percent slopes.
Blanchard fine sand, 0 to 7 percent slopes, wind eroded.
Blanchard loamy fine sand, 0 to 3 percent slopes.
Blanchard loamy fine sand, 3 to 7 percent slopes.

These soils are low in fertility, and they have a low capacity for holding moisture for plants. The hazard of wind and water erosion is high. The fine, sandy surface soil is easily blown unless protected.

Grass is best suited to these soils, but it will gradually thin out and be replaced by weeds. Before this occurs, small grains should be grown for 1 or 2 years, and grass reseeded in the grain stubble. Soils that are used for small grains should be tilled to leave a stubble mulch on the surface to control wind and water erosion. Field windbreaks also help to prevent erosion. Grass should not be overgrazed.

Fertilizer should be added according to crop needs and soil tests. The yield and vigor of pasture on some of these soils are improved by sprinkler irrigation.

CAPABILITY UNIT IVs-1

Shallow to moderately deep, dark-colored, loamy, nearly level to gently rolling soils that are underlain by sand and gravel

Birch fine sandy loam, 0 to 5 percent slopes.
Chamokane and Banks soils, 0 to 4 percent slopes.
Kalispell gravelly loam, moderately deep over gravel, 3 to 7 percent slopes.
Kalispell gravelly loam, moderately deep over gravel, 7 to 12 percent slopes.
Kiwanis-Birch fine sandy loams, 0 to 5 percent slopes.
Kiwanis-Birch loams, 0 to 4 percent slopes.
Mires gravelly loam, 0 to 3 percent slopes.
Mires gravelly loam, 3 to 7 percent slopes.
Mires loam, 3 to 7 percent slopes.
Mires loam, 7 to 12 percent slopes.

These soils generally occur where rainfall is low in the Area. In addition, their texture and shallowness to strata of sand and gravel lower their capacity to hold moisture for plants. Their chief limitation, therefore, is droughtiness. The risk of erosion is slight.

These soils are suited best to grasses. If management is good, they can be used for hay or pasture. The desirable grasses eventually thin out and are replaced by weeds and by bluegrass and other low-producing grasses. Before this occurs, the soil should be seeded to small grain for 1 or 2 years, and desirable grasses then reseeded in the grain stubble.

Grazing should be light or moderate. Some grass is irrigated by sprinklers to improve the vigor and yield of forage.

CAPABILITY UNIT IVs-2

Deep, moderately well drained, light-colored, clayey, nearly level soils

The soil in this capability unit—Depew silty clay, 0 to 3 percent slopes—was originally forested, but about 20 percent of the acreage has been cleared for cultivation. In many areas the compact upper subsoil has been mixed with the surface soil. Consequently, plowed fields become rough and cloddy and a good seedbed is difficult to prepare. In addition, this soil warms slowly in spring, is slowly drained, and in places water may be ponded part of the time. It is rather undesirable for farming.

Yields of crops for several years after clearing are poor because the soil has a low supply of organic matter. Yields can be increased by the addition of fertilizer and organic matter.

Grasses are best suited to this soil, but an occasional crop of wheat can also be grown. Winter wheat is more desirable than spring wheat. The grasses are usually allowed to grow as long as the stand is vigorous. When the stand thins out or becomes too weedy, the soil is plowed and used for wheat 1 or 2 years. Intermediate wheatgrass and other grasses suitable for heavy soils are then seeded in the grain stubble. Alfalfa is sometimes grown to make the subsoil more porous.

All available organic matter should be applied to improve soil tilth. Fertilizer should be applied according to crop needs and soil tests.

CAPABILITY UNIT IVs-3

Deep and moderately deep, light-colored, sandy, nearly level to rolling soils

Haskill fine sand, 0 to 7 percent slopes.
Haskill loamy fine sand, 0 to 7 percent slopes.
McCaffery coarse sand, 0 to 5 percent slopes.
McCaffery loamy fine sand, 0 to 3 percent slopes.
McCaffery loamy fine sand, 3 to 7 percent slopes.
McCaffery loamy fine sand, 7 to 12 percent slopes.

Most of the acreage is forested, but a small part has been cleared and is cultivated. These soils have a low capacity to hold available moisture. The risk of wind erosion is moderate.

Yields of crops for several years after clearing are poor because of the low supplies of organic matter and nitrogen in these soils. These can be increased, however, by adding fertilizer and organic matter.

Grasses are suited best to these soils, but an occasional crop of small grain may also be grown. Before the grasses are replaced by weeds, the soil should be seeded to small grain for 1 or 2 years. The desirable grasses should then be reseeded in the grain stubble. To reduce wind erosion use stripcropping, with alternate strips of small grain and grass. This is better than planting the fields entirely in grass or in grain. The soils are suitable for tree planting.

Crop residues should be used to increase the organic matter in the soil. Fertilizers should be applied according to crop needs and soil tests.

Sprinkler irrigation is used in some areas to establish grass and to increase its carrying capacity for grazing.

CAPABILITY UNIT IVs-4

Shallow and moderately deep, loamy to silty, nearly level or gently sloping soils that are underlain by coarse material

Krause gravelly loam, 0 to 3 percent slopes.
Krause gravelly loam, 3 to 7 percent slopes.
Waits cobbly silt loam, fans, 0 to 3 percent slopes.
Waits cobbly silt loam, fans, 3 to 7 percent slopes.

Most of these soils are forested, but small areas have been cleared for pasture and cultivation. These soils have a very low capacity to hold moisture that plants can use. Erosion is not a problem.

Yields of crops for several years after clearing are poor on these soils because of the low supply of organic matter and nitrogen. They can be increased if fertilizer and organic matter are applied.

The cultivated areas are used mainly for grass. Before the grass thins out and is replaced by weeds, the soil should be seeded to small grain for 1 or 2 years. The desirable grasses should then be reseeded in the small-grain stubble. Organic matter should be increased in these soils. Fertilizer should be added according to crop needs and soil tests.

These soils are not well suited to irrigation. They are good for the production of Christmas trees.

CAPABILITY UNIT Vs-1

Stony, nearly level or gently sloping soils

Prospect stony loam, 3 to 7 percent slopes.
Waits stony silt loam, 0 to 7 percent slopes.
Waits stony silt loam, fans, 0 to 7 percent slopes.
Waits and Krause stony loams, 0 to 7 percent slopes.
Whitefish cobbly silt loam, 0 to 7 percent slopes.
Whitefish stony silt loam, 0 to 7 percent slopes.
Yeoman stony loam, 0 to 7 percent slopes.
Yeoman stony loam, moderately deep over sand, 0 to 7 percent slopes.

These soils cannot be cultivated; they contain too many large stones and boulders. They are best for grass or trees. High yields of forage or wood can be obtained if management is good.

If the stones and boulders are removed, the management of these soils then is very similar to that of the nonstony soil types of the same series.

CAPABILITY UNIT Vw-1

Poorly drained soils

Alluvial land, poorly drained.
Muck and Peat.
Radnor silt loam, 0 to 3 percent slopes.
Radnor silty clay loam, 0 to 3 percent slopes.

A large part of the acreage is not in productive use. Most areas are too wet for satisfactory pasture, but they are grazed to the extent that cattle can get over them. Some areas dry out enough late in summer to allow the mowing of wild hay.

Grasses are best suited to these soils, but their use as pasture is governed by the degree of wetness. However, yields of hay and forage can be improved if the soils are drained.

CAPABILITY UNIT VIe-1

Stony or coarse-textured, rolling to very steep soils

Blanchard very fine sandy loam, 12 to 20 percent slopes.
Blanchard very fine sandy loam, 20 to 45 percent slopes.
Creston silt loam, 12 to 45 percent slopes.
Half Moon soils, 12 to 45 percent slopes.
Half Moon very fine sandy loam, 7 to 12 percent slopes.
Kalispell gravelly loam, moderately deep over gravel, 12 to 40 percent slopes.
Kalispell loam, moderately deep over gravel, 7 to 12 percent slopes.
Kalispell loam, moderately deep over sand, 12 to 40 percent slopes.
Kalispell-Tuffit silt loams, 7 to 20 percent slopes.
Krause gravelly loam, 7 to 12 percent slopes.
Krause gravelly loam, 12 to 35 percent slopes.
Mires gravelly loam, 7 to 12 percent slopes.
Mires gravelly loam, 12 to 30 percent slopes.
Prospect stony loam, 7 to 12 percent slopes.
Prospect stony loam, 12 to 20 percent slopes.
Prospect stony loam, 20 to 45 percent slopes.
Waits stony silt loam, 7 to 12 percent slopes.
Waits stony silt loam, 12 to 35 percent slopes.
Waits and Krause stony loams, 7 to 12 percent slopes.
Waits and Krause stony loams, 12 to 40 percent slopes.
Whitefish cobbly silt loam, 7 to 12 percent slopes.
Whitefish cobbly silt loam, 12 to 20 percent slopes.
Whitefish cobbly silt loam, 20 to 45 percent slopes.
Whitefish gravelly silt loam, 12 to 25 percent slopes.
Whitefish silt loam, 12 to 35 percent slopes.
Whitefish stony silt loam, 7 to 12 percent slopes.
Whitefish stony silt loam, 12 to 20 percent slopes.
Whitefish stony silt loam, 20 to 45 percent slopes.
Yeoman cobbly loam, moderately deep over sand, 7 to 12 percent slopes.
Yeoman cobbly loam, moderately deep over sand, 12 to 25 percent slopes.
Yeoman gravelly loam, 12 to 30 percent slopes.
Yeoman gravelly loam, moderately deep over sand, 7 to 12 percent slopes.
Yeoman gravelly loam, moderately deep over sand, 12 to 20 percent slopes.
Yeoman gravelly loam, moderately deep over sand, 20 to 40 percent slopes.
Yeoman stony loam, 7 to 12 percent slopes.
Yeoman stony loam, 12 to 35 percent slopes.
Yeoman stony loam, moderately deep over sand, 7 to 20 percent slopes.
Yeoman stony loam, moderately deep over sand, 20 to 35 percent slopes.

These soils are generally too stony, are too steep, or have other limitations that make them unsuitable for cultivation. Good management is needed to get the best production of grass and trees. The hazard of wind and water erosion is high. These soils will blow or wash easily unless protected.

If the stones and boulders are removed from slopes of less than 12 percent, the soils can be used and managed in nearly the same way as the nonstony soils of the same series.

CAPABILITY UNIT VIes-1

Deep, excessively drained, very sandy, rolling to very steep soils

Blanchard fine sand, 7 to 12 percent slopes.
Blanchard fine sand, 12 to 35 percent slopes.
Blanchard fine sand, 7 to 12 percent slopes, wind eroded.
Blanchard fine sand, 12 to 35 percent slopes, wind eroded.
Blanchard loamy fine sand, 7 to 20 percent slopes.
Blanchard loamy fine sand, 20 to 45 percent slopes.
Haskill fine sand, 7 to 12 percent slopes.
Haskill fine sand, 12 to 45 percent slopes.
Haskill loamy fine sand, 7 to 20 percent slopes.
McCaffery loamy fine sand, 12 to 30 percent slopes.

These soils are capable of holding moderate amounts of moisture. Bare surfaces are subject to moderately severe wind and water erosion.

Grass and trees are best suited to these soils. Good management is needed to maintain yields.

CAPABILITY UNIT VIs-1

Mixed alluvial soils that are subject to flooding, droughtiness, and seasonal high water table

Alluvial land, well drained.
Banks loamy fine sand, 0 to 4 percent slopes.
Banks very fine sandy loam, 0 to 4 percent slopes.
Birch gravelly loam, 0 to 3 percent slopes.

These soils are generally along streams that are subject to overflow. Some of the acreage has been washed away through undercutting of stream banks.

The soils of this unit have a high water table part of the time, but in summer they are droughty. These areas should be cleared and developed as meadow or pasture. The best spots may be suitable for cultivation. Information as to the feasibility of clearing any areas of these soils for cultivation can be obtained from the county agricultural agent or the Soil Conservation District office.

CAPABILITY UNIT VIs-2

Deep, loamy, nearly level to steep soils that are moderately saline, saline, and strongly alkaline

Demers-Kalispell silt loams, 0 to 3 percent slopes.
Demers-Kalispell silt loams, 3 to 7 percent slopes.
Demers-Kalispell silt loams, 7 to 25 percent slopes.
Prospect-Tuffit silt loams, 7 to 20 percent slopes.
Saline-alkali land.

This capability unit consists of complexes that contain a high percentage of the Demers and Tuffit soils, which are too saline and alkaline to produce good crops. Suitable seedbeds cannot be prepared in the heavy clay, and surface crusting prevents plants from growing. Runoff is high. Unless the surface is protected by vegetation, moderate erosion occurs.

These soils are best suited to Alta fescue, tall wheatgrass, or other alkali-tolerant grasses. Grazing must be controlled to keep pastures in good condition.

The more nearly level areas need drainage to remove standing water that might drown out the grass. Drainage also helps to remove salts from the soils.

CAPABILITY UNIT VIIs-1

Shallow and stony, moderately steep to very steep soils

This capability unit contains one miscellaneous land type, Mountainous land. This land is on hills and mountains within the alluvial plain of the valley floor and those mountains around the valley that are included in the surveyed area. The land type consists mainly of barren rock slopes and of Waits stony silt loam and Whitefish cobbly silt loam on various slopes. Some areas are only bare rock; others are forested.

This unit is suitable only for forest. On the deeper soils, trees grow large enough to harvest. The forest should be properly managed for maximum yield.

CAPABILITY UNIT VIIIs-1

Coarse sand and gravel that is flooded part of the time and has little or no vegetative cover

This capability unit contains one land type, Riverwash, that consists of coarse sand and gravel, is flooded part of the time, and has little or no vegetation.

The sand and gravel is recent. It is deposited along the stream channels and, during floods, may be removed and deposited in another location downstream. Riverwash has no agricultural use.

Estimated Yields

The estimated average acre yields that can be expected from the principal crops grown on soils of the Upper Flathead Valley Area, under two levels of management, are given in table 4. The estimates are based mainly on information gathered through interviews with farmers, agricultural workers, and others who have observed yields. The estimates give the relative productivity of soils shown on the soil map.

Yields in columns A are obtained by practices followed by many farmers in the Area. Such management does not include use of regular cropping systems, green-manure crops, and conservation measures. Yields in columns B are those expected through adequate fertilization, the practice of soil and moisture conservation, and the use of regular cropping systems and green-manure crops. Yields higher than those given in columns B are not uncommon and can be obtained in favorable seasons if management is good.

Yields may change greatly in the future as new plant varieties and cultural practices are developed and additional plant diseases and insects appear.

TABLE 4.—*Estimated average acre yields of principal crops*

[Yields in columns A can be expected under prevailing management. This management does not include use of regular cropping systems, green-manure crops, and conservation measures. Those in columns B can be expected under management that includes the use of adequate fertilizer, good cropping systems, green-manure crops, and adequate conservation measures. This is about equivalent to the management suggested for the capability units. Absence of yield indicates that the crop is seldom, if ever, grown, or the soil is not suited to its production]

Soil [1]	Spring wheat		Winter wheat		Oats		Barley		Potatoes		Alfalfa	
	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Birch fine sandy loam, 0 to 5 percent slopes	8	12	------	------	------	------	12	18	------	------	------	------
Blanchard fine sand, 0 to 7 percent slopes	8	12	------	------	------	------	12	18	------	------	------	------
Blanchard fine sand, 0 to 7 percent slopes, wind eroded	8	12	------	------	------	------	------	------	------	------	------	------
Blanchard loamy fine sand, 0 to 3 percent slopes	13	17	------	------	20	23	20	23	------	------	------	------
Blanchard loamy fine sand, 3 to 7 percent slopes	11	15	------	------	20	23	20	23	------	------	------	------
Blanchard very fine sandy loam, 0 to 7 percent slopes	------	------	18	24	------	------	20	25	------	------	1.0	3.0
Blanchard very fine sandy loam, 7 to 12 percent slopes	------	------	10	12	------	------	16	20	------	------	------	------
Chamokane soils, 0 to 3 percent slopes	12	21	20	27	20	35	20	25	------	------	1.0	1.5
Chamokane soils, 3 to 7 percent slopes	12	21	20	27	20	35	20	25	------	------	1.0	1.5
Chamokane and Banks soils, 0 to 4 percent slopes	10	15	12	18	------	------	15	20	------	------	------	------
Corvallis silty clay loam, 0 to 3 percent slopes	27	35	22	30	40	50	33	40	------	------	2.0	3.0
Creston silt loam, 0 to 3 percent slopes	23	33	38	50	28	30	38	52	200	450	2.0	4.0
Creston silt loam, 3 to 7 percent slopes	21	32	35	48	26	30	35	50	175	425	1.8	3.5
Creston silt loam, 7 to 12 percent slopes	20	30	32	45	24	28	32	45	------	------	1.5	3.0
Demers-Kalispell silt loams, 0 to 3 percent slopes	8	10	10	12	------	------	------	------	------	------	------	------
Depew silty clay, 0 to 3 percent slopes	7	12	10	20	15	20	15	20	------	------	.7	1.2
Depew silty clay loam, 0 to 3 percent slopes	15	25	25	35	30	38	27	35	------	------	2.0	3.0
Depew silty clay loam, 3 to 7 percent slopes	13	22	21	30	25	30	22	28	------	------	1.5	2.0
Flathead fine sandy loam, 0 to 3 percent slopes	20	25	30	40	30	40	25	35	150	400	1.5	3.0
Flathead fine sandy loam, 3 to 7 percent slopes	18	23	27	35	27	35	20	30	125	350	1.0	2.0
Flathead fine sandy loam, 7 to 20 percent slopes	10	14	15	18	------	------	12	16	------	------	------	------
Flathead sandy loam, 0 to 7 percent slopes	17	22	25	35	22	38	30	40	------	------	1.5	2.5
Flathead very fine sandy loam, 0 to 3 percent slopes	18	24	28	35	26	34	32	45	130	200	1.5	2.5
Flathead very fine sandy loam, 3 to 7 percent slopes	15	22	25	32	22	30	28	40	125	175	1.5	2.5
Flathead-Creston loams, 0 to 3 percent slopes	16	24	28	35	25	35	27	40	80	100	1.0	2.0
Flathead-Mires loams, 0 to 3 percent slopes	10	14	15	24	------	------	12	16	------	------	1.0	1.5
Half Moon silt loam, 0 to 3 percent slopes	20	25	30	40	32	40	28	32	------	------	2.0	2.5
Half Moon silt loam, 3 to 8 percent slopes	18	23	28	38	30	38	25	30	------	------	1.7	2.2
Half Moon very fine sandy loam, 0 to 3 percent slopes	20	26	28	42	32	50	32	40	90	125	2.0	2.5
Half Moon very fine sandy loam, 3 to 7 percent slopes	18	24	26	40	30	48	30	38	80	100	1.5	2.0
Half Moon-Haskill complex, 0 to 3 percent slopes	17	21	26	32	26	32	30	36	80	100	2.0	2.5
Half Moon-Haskill complex, 3 to 7 percent slopes	15	20	25	30	25	30	28	35	------	------	2.0	2.5
Haskill loamy fine sand, 0 to 7 percent slopes	12	18	20	25	23	28	28	32	------	------	------	------
Kalispell fine sandy loam, moderately deep over sand, 0 to 7 percent slopes	8	15	12	20	------	------	------	------	------	------	------	------
Kalispell gravelly loam, moderately deep over gravel, 3 to 7 percent slopes	8	13	12	18	------	------	------	------	------	------	------	------
Kalispell gravelly loam, moderately deep over gravel, 7 to 12 percent slopes	8	13	12	18	------	------	------	------	------	------	------	------
Kalispell loam, 0 to 3 percent slopes	14	18	22	32	20	25	22	28	80	125	1.0	2.0
Kalispell loam, 0 to 3 percent slopes, wind eroded	10	12	20	28	18	22	20	26	70	100	.7	1.5
Kalispell loam, 3 to 7 percent slopes	12	16	20	30	18	22	20	25	75	125	1.0	2.0
Kalispell loam, 3 to 7 percent slopes, wind eroded	8	10	16	26	15	20	15	20	60	80	.7	1.5
Kalispell loam, 7 to 12 percent slopes	10	15	18	25	15	20	15	22	------	------	.7	1.5
Kalispell loam, moderately deep over gravel, 0 to 7 percent slopes	9	12	18	21	15	22	15	22	------	------	.7	1.5
Kalispell loam, moderately deep over gravel, 7 to 12 percent slopes	8	10	15	18	12	20	12	20	------	------	.7	1.5
Kalispell loam, moderately deep over sand, 0 to 3 percent slopes	12	17	18	21	18	27	22	27	------	------	.7	1.5
Kalispell loam, moderately deep over sand, 3 to 7 percent slopes	10	15	15	20	15	25	20	25	------	------	.7	1.5
Kalispell loam, moderately deep over sand, 7 to 12 percent slopes	8	12	12	16	12	20	15	20	------	------	.5	1.0

[1] Soils not suitable for any of the principal crops have been omitted from this table.

TABLE 4.—*Estimated average acre yields of principal crops*—Continued

Soil	Spring wheat		Winter wheat		Oats		Barley		Potatoes		Alfalfa	
	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Kalispell silt loam, heavy subsoil, 0 to 3 percent slopes	12	18	22	30	20	25	22	30	90	150	1.0	2.0
Kalispell silt loam, moderately deep over sand, 0 to 7 percent slopes	13	20	24	30	20	28	20	28	------	------	7	1.5
Kalispell-Demers silt loams, 0 to 3 percent slopes	8	12	15	20	------	------	------	------	------	------	------	------
Kalispell-Demers silt loams, 3 to 12 percent slopes	6	10	12	18	------	------	------	------	------	------	------	------
Kalispell-Tuffit silt loams, 0 to 3 percent slopes	8	12	12	18	------	------	------	------	------	------	------	------
Kalispell-Tuffit silt loams, 3 to 7 percent slopes	7	10	10	15	------	------	------	------	------	------	------	------
Kiwanis fine sandy loam, 0 to 4 percent slopes	8	13	8	13	------	------	------	------	------	------	------	------
Kiwanis loam, 0 to 3 percent slopes	10	14	16	20	22	28	20	28	------	------	1.0	1.5
Kiwanis loam, 3 to 9 percent slopes	8	12	14	18	20	26	18	25	------	------	1.0	1.5
Kiwanis-Birch fine sandy loams, 0 to 5 percent slopes	------	------	8	12	------	------	------	------	------	------	------	------
Kiwanis-Birch loams, 0 to 4 percent slopes	------	------	10	12	------	------	------	------	------	------	------	------
Krause gravelly loam, 0 to 3 percent slopes	------	------	8	12	------	------	------	------	------	------	------	------
Krause gravelly loam, 3 to 7 percent slopes	------	------	6	10	------	------	------	------	------	------	------	------
McCaffery loamy fine sand, 0 to 3 percent slopes	10	15	15	18	------	------	15	22	------	------	------	------
McCaffery loamy fine sand, 3 to 7 percent slopes	8	12	12	15	------	------	12	20	------	------	------	------
McCaffery loamy fine sand, 7 to 12 percent slopes	7	10	10	13	------	------	10	15	------	------	------	------
Mires gravelly loam, 0 to 3 percent slopes	8	10	8	12	------	------	------	------	------	------	.7	1.0
Mires gravelly loam, 3 to 7 percent slopes	8	10	8	12	------	------	------	------	------	------	.7	1.0
Mires loam, 0 to 3 percent slopes	8	12	12	16	------	------	15	18	------	------	.7	1.0
Mires loam, 3 to 7 percent slopes	6	10	10	14	------	------	12	15	------	------	.7	1.0
Mires loam, 7 to 12 percent slopes	6	10	10	14	------	------	12	15	------	------	.7	1.0
Prospect loam, 0 to 3 percent slopes	12	16	20	24	------	------	18	22	------	------	.7	1.5
Prospect loam, 3 to 7 percent slopes	10	14	18	22	------	------	15	20	------	------	.7	1.5
Prospect loam, 7 to 12 percent slopes	8	12	15	20	------	------	12	16	------	------	.7	1.5
Prospect loam, 12 to 20 percent slopes	------	------	12	16	------	------	------	------	------	------	.7	1.5
Prospect-Tuffit silt loams, 0 to 3 percent slopes	8	12	10	15	------	------	10	16	------	------	------	------
Prospect-Tuffit silt loams, 3 to 7 percent slopes	8	12	10	15	------	------	10	16	------	------	------	------
Selle fine sandy loam, 0 to 3 percent slopes	14	18	20	22	22	24	24	35	------	------	2.0	3.0
Selle fine sandy loam, 3 to 8 percent slopes	12	16	18	20	20	22	22	32	------	------	2.0	3.0
Somers silt loam, 0 to 3 percent slopes	18	22	28	32	25	32	32	38	------	------	1.0	2.0
Somers silt loam, 3 to 7 percent slopes	16	20	26	30	22	30	30	35	------	------	1.0	2.0
Somers silty clay, 0 to 4 percent slopes	10	15	15	22	22	28	22	28	------	------	1.0	2.0
Somers silty clay loam, 0 to 3 percent slopes	18	22	26	32	26	32	32	38	------	------	1.0	2.0
Somers silty clay loam, 3 to 8 percent slopes	17	22	25	30	25	30	30	36	------	------	1.0	2.0
Stryker silt loam, 0 to 3 percent slopes	22	30	25	32	32	40	32	40	------	------	2.0	2.5
Stryker silt loam, sandy subsoil, 0 to 3 percent slopes	18	22	20	24	30	35	30	35	------	------	------	------
Stryker silty clay loam, 0 to 3 percent slopes	20	28	22	30	30	38	30	38	------	------	------	------
Swims silt loam, 0 to 3 percent slopes	18	22	26	31	32	36	32	36	------	------	2.0	3.0
Swims silt loam, 3 to 7 percent slopes	18	22	26	31	32	36	32	36	------	------	2.0	3.0
Swims silty clay loam, 0 to 4 percent slopes	18	22	26	31	32	36	32	36	------	------	2.0	2.5
Tally, Blanchard, and Flathead soils, 0 to 3 percent slopes	13	18	22	28	21	28	24	30	80	100	1.0	1.5
Tally, Blanchard, and Flathead soils, 0 to 3 percent slopes, wind eroded	13	18	22	28	21	28	24	30	80	100	1.0	1.5
Tally, Blanchard, and Flathead soils, 3 to 7 percent slopes	12	16	20	26	20	26	22	28	70	100	1.0	1.5
Tally, Blanchard, and Flathead soils, 3 to 7 percent slopes, wind eroded	10	14	16	24	16	24	18	25	------	------	.7	1.0
Tally, Blanchard, and Flathead soils, 7 to 12 percent slopes	10	14	18	25	18	25	20	25	------	------	1.0	1.5
Tally, Blanchard, and Flathead soils, 7 to 12 percent slopes, wind eroded	7	10	10	15	12	16	15	20	------	------	.7	1.0
Tuffit-Somers silty clay loams, 0 to 5 percent slopes	------	------	14	18	------	------	------	------	------	------	------	------
Waits cobbly silt loam, fans, 0 to 3 percent slopes	------	------	18	30	------	------	------	------	------	------	2.5	3.0
Waits silt loam, 0 to 7 percent slopes	------	------	26	32	35	45	------	------	------	------	2.5	3.0
Waits silt loam, fans, 0 to 4 percent slopes	------	------	28	32	35	45	------	------	------	------	2.5	3.0
Waits stony silt loam, fans, 0 to 7 percent slopes	------	------	12	18	------	------	------	------	------	------	------	------
Walters silt loam, 0 to 4 percent slopes	20	25	28	35	30	35	32	38	------	------	1.5	2.5
Walters very fine sandy loam, 0 to 7 percent slopes	16	20	22	28	25	32	28	35	------	------	1.0	2.0
Whitefish cobbly silt loam, 0 to 7 percent slopes	13	17	16	20	18	28	20	25	------	------	1.0	1.5
Whitefish gravelly silt loam, 0 to 7 percent slopes	14	17	20	23	22	28	24	28	------	------	1.0	1.5
Whitefish gravelly silt loam, 7 to 12 percent slopes	12	15	18	21	20	26	22	26	------	------	1.0	1.5

TABLE 4.—*Estimated average acre yeilds of principal crops*—Continued

Soil	Spring wheat		Winter wheat		Oats		Barley		Potatoes		Alfalfa	
	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Whitefish silt loam, 0 to 3 percent slopes	15	20	24	28	23	27	25	30	------	------	1. 0	1. 5
Whitefish silt loam, 3 to 7 percent slopes	13	18	22	26	20	25	22	28	------	------	1. 0	1. 5
Whitefish silt loam, 7 to 12 percent slopes	12	17	20	25	18	23	20	25	------	------	1. 0	1. 5
Yeoman cobbly loam, moderately deep over sand, 0 to 3 percent slopes	12	17	16	25	------	------	18	26	------	------	. 7	1. 5
Yeoman cobbly loam, moderately deep over sand, 3 to 7 percent slopes	10	15	15	23	------	------	15	23	------	------	. 7	1. 5
Yeoman cobbly loam, moderately deep over sand, 7 to 12 percent slopes	8	12	10	18	------	------	12	20	------	------	. 7	1. 5
Yeoman gravelly loam, 0 to 7 percent slopes	15	18	24	28	21	25	24	28	------	------	1. 0	1. 5
Yeoman gravelly loam, 7 to 12 percent slopes	12	15	20	25	18	22	20	25	------	------	1. 0	1. 5
Yeoman gravelly loam, moderately deep over sand, 0 to 3 percent slopes	13	18	18	26	------	------	18	25	------	------	. 7	1. 5
Yeoman gravelly loam, moderately deep over sand, 3 to 7 percent slopes	10	15	15	23	------	------	15	23	------	------	. 7	1. 5
Yeoman gravelly loam, moderately deep over sand, 7 to 12 percent slopes	8	13	12	20	------	------	12	20	------	------	. 5	1. 0
Yeoman loam, moderately deep over sand, 0 to 3 percent slopes	10	12	22	26	------	------	20	26	------	------	. 7	1. 5
Yeoman loam, moderately deep over sand, 3 to 7 percent slopes	9	12	20	25	------	------	18	24	------	------	. 7	1. 5
Yeoman loam, moderately deep over sand, 7 to 12 percent slopes	8	10	16	20	------	------	16	20	------	------	. 5	1. 0
Yeoman silt loam, 0 to 7 percent slopes	22	27	34	40	25	35	33	38	120	350	1. 5	2. 0
Yeoman silt loam, 7 to 12 percent slopes	20	25	32	38	23	33	30	35	110	325	1. 5	2. 0

Woodlands [3]

Logging, clearing, and fire have greatly changed the vegetation in the Upper Flathead Valley Area. Except for scattered stands, the virgin timber has been cut, and second-growth forest has replaced it. Additional acreage of the more nearly level, better soils are still being cleared for farming. As a rule, the remaining forest should be left and managed for forest products.

Forests encircle the Upper Flathead Valley Area and extend up the tributaries of the Flathead River. The main valley is fairly open. Forests and cropland are often intermixed, but forests are inseparable parts of the land-use pattern.

Forest cover types

Forests are generally classified as forest cover types. A forest cover type is a stand of trees, the composition and development of which is due to an environment that differentiates it from other stands of trees. The forest cover type is identified by the predominant species, which must make up at least 50 percent of the stand. Forests vary considerably in composition, and the types are not always distinctly separated because they blend into one another. Most forests represent one or more stages in the highest possible vegetative development allowed by the soil and climate.

The forests of the Upper Flathead Valley are subdivided into six forest cover types. They are ponderosa pine, western larch, Douglas-fir, lodgepole pine, mixed conifer, and hardwoods.

[3] Prepared by L. S. MATTHEW, woodland conservationist, Soil Conservation Service, and R. C. MCCONNELL, soil scientist, Forest Service.

PONDEROSA PINE TYPE

This forest type in many places consists of ponderosa pine in pure stands (fig. 12). In mixed forests, the species commonly associated with it are Douglas-fir, western larch, and lodgepole pine. Ponderosa pine grows

Figure 12.—**Young, vigorous ponderosa pine near Kalispell.**

Figure 13.—**Second-growth Douglas-fir can be managed for Christmas trees.**

under a wide range of climatic conditions, but in the Upper Flathead Valley Area, it occurs more extensively in the warmer and drier sites. On the poorer soils, ponderosa pine is characteristically in dense stands and has little growth. The amount of merchantable wood developed by a stand depends, among other things, upon adequate initial stocking, sufficient growing space for each tree throughout the life of the stand, and the quality of the site.

DOUGLAS-FIR TYPE

Douglas-fir, predominant in this forest type, is commonly associated with larch, ponderosa pine, lodgepole pine, and spruce. It may occur in pure stands. In some sites it is an understory in older stands of ponderosa pine. Douglas-fir usually reestablishes itself following the logging of the original trees if a seed source is available and other conditions are favorable. Young second-growth fir is especially valuable for Christmas trees (fig. 13). These can be produced in a short time, but intensive management is needed.

WESTERN LARCH TYPE

Western larch, the main tree species in this type, generally grows in mixtures with Douglas-fir, lodgepole pine, Engelmann spruce, grand fir, and ponderosa pine. When associated with Douglas-fir, it grows taller and contains more clear wood. Larch will not grow in shade; consequently, it may be replaced gradually by Douglas-fir. It is one of the species that becomes established on burned-over areas.

LODGEPOLE PINE TYPE

Lodgepole pine, the main species in this type, grows in fairly pure stands at higher elevations. At the lower elevations of its range, it is associated with ponderosa pine and Douglas-fir. On moist sites it is associated with spruce and alpine fir. Lodgepole pine usually occupies burned-over areas. It is often in dense, overcrowded stands that have slow growth.

MIXED CONIFER TYPE

This type mainly occupies the cooler and moister sites in the southeastern part of the Area. These sites are potentially some of the most productive of forest. The more valuable white pine, ponderosa pine, western larch, and Douglas-fir have been repeatedly cut. Consequently, the less valuable species, mainly grand fir, are now dominant. Large, decayed trees of this species occupy most of the acreage. Seedlings of grand fir and alpine fir grow readily under the large trees. White pine is the most valuable species in this type, but it is subject to blister rust.

HARDWOOD TYPE

Cottonwood, the dominant species, is commonly associated with willow, birch, and alder. The hardwood type usually occupies flood plains along the larger streams where moisture is plentiful. Cottonwood has little commercial value. It occupies extensive areas subject to overflow and protects streambanks and helps control erosion.

Soil productivity

Like other plants, trees grow more rapidly and produce more wood on some soils than on others. Table 5 shows the productivity ratings of most soil types for the principal forest trees that grow in the surveyed Area. The capacity of soil to produce wood can be measured and described in units per acre just as the productivity of cropland can be measured in bushels per acre. Wood crops are measured in different units, and it is therefore more convenient to use the site index, which is the height of the tallest trees at a definite age, as an indicator of the productivity of forest soils.

Management

The difference in productivity of various soils is a factor to be considered in management. Soils of low productivity usually justify only protection from fire, the control of grazing, and other minimum practices. On the better soils, thinning, pruning, and other intensive practices will be profitable.

PROTECTION

Protection of trees from fire, harmful grazing, insects and disease, and erosion usually are given the highest management priority. The State fire laws should be com-

TABLE 5.—*Relative productivity ratings* [1] *of soil types for forest trees, Upper Flathead Valley Area, Mont.*

[Absence of data indicates the tree species generally does not grow on soil]

Soil	Ponderosa pine	Douglas-fir	Western larch	Lodgepole pine	Mixed conifer	Vegetation and soil characteristics
Alluvial land, well drained	High	High	High	High		Coniferous and hardwood species; subirrigated.
Banks loamy fine sand	High	High				Coniferous and hardwood species; subirrigated.
Banks very fine sandy loam	High	High				Coniferous and hardwood species; subirrigated.
Birch fine sandy loam	High	High	High	High		Coniferous and hardwood species; subirrigated.
Birch gravelly loam	Medium	Medium	Medium	Medium		Shallow soil.
Blanchard fine sand	Low	Low				Limited moisture-holding capacity.
Blanchard very fine sandy loam	Medium					Limited moisture-holding capacity.
Chamokane soils	High	High	High			Subirrigated.
Creston silt loam	Medium	Medium	Medium			
Depew silty clay	Medium	Low	Low	Low		Poorly drained.
Depew silty clay loam	Medium	Low	Low	Low		Poorly drained.
Flathead fine sandy loam	Medium					Limited moisture-holding capacity.
Flathead sandy loam	Medium					Limited moisture-holding capacity.
Flathead very fine sandy loam	Medium					Limited moisture-holding capacity.
Half Moon silt loam	Medium	Medium	Medium	Medium		Moderately deep to lime.
Half Moon very fine sandy loam	Medium	Medium	Medium	Medium		Moderately deep to lime.
Haskill fine sand	High	Medium	Medium	Medium		Limited moisture-holding capacity.
Haskill loamy fine sand	High	Medium	Medium	Medium		Limited moisture-holding capacity.
Kalispell loam						Vegetation mostly bunchgrass.
Kiwanis loam	High	High	High			Subirrigated; mostly deep soil.
Krause gravelly loam	Low	Medium	Medium	Medium	Medium	Limited moisture-holding capacity.
McCaffery loamy fine sand	High	High	High	High	High	
Mires gravelly loam	Medium					
Prospect loam	Low					
Prospect stony loam	Low					
Radnor silt loam		Medium	Medium	Medium		Poorly drained.
Radnor silty clay loam		Medium	Medium	Medium		Poorly drained.
Selle fine sandy loam	High	High	High	High	High	
Somers silt loam	High					Subirrigated part of the time.
Stryker silt loam		High	High	High	High	Subirrigated; slowly permeable.
Stryker silty clay loam		Medium	Medium	Medium	Medium	Subirrigated; slowly permeable.
Swims silt loam	High	High	High	High		Subirrigated.
Swims silty clay loam	High	High	High	High		Subirrigated.
Waits silt loam	High	High	High	High	High	Deep soil.
Walters silt loam	High	High	High	High		Subirrigated; deep and permeable.
Walters very fine sandy loam	High	High	High	High	High	Subirrigated; deep and permeable.
Whitefish cobbly silt loam	Medium	Medium	Medium	Medium		Limy lower substrata; permeable.
Whitefish silt loam	Medium	Medium	Medium	Medium		Limy lower substrata; permeable.
Yeoman gravelly loam	High					
Yeoman gravelly loam, moderately deep over sand.	Low					Limited moisture-holding capacity.
Yeoman stony loam	High					Permeable.
Yeoman stony loam, moderately deep over sand.	Low					Limited moisture-holding capacity.

[1] The relative productivity ratings in terms of heights of the tallest trees at a definite age (site index) are as follows:
For ponderosa pine (age 100 years):
High.—85 feet or more.
Medium.—57 to 84 feet.
Low.—56 feet or less.
For western larch and Douglas-fir (age 50 years):
High.—56 feet or more.
Medium.—45 to 55 feet.
Low.—44 feet or less.
For lodgepole pine (age 80 years):
High.—76 feet or more.
Medium.—56 to 75 feet.
Low.—55 feet or less.
For mixed conifers (age 50 years):
High.—66 feet or more.
Medium.—45 to 65 feet.
Low.—44 feet or less.

plied with. In addition, the disposal of slash, construction and maintenance of access roads, posting of fire signs, and care in the use of fire help prevent forest fires. As a rule, well-regulated grazing does not injure coniferous forests. The forage in woodland pasture is generally not so good as that from grassland, or open range.

Proper management that leaves only healthy trees generally will control insects and diseases. Insect and disease outbreaks that reach epidemic proportions may be beyond the control of most woodland owners and should be reported to the State forester's office.

Erosion is generally low on well-managed woodlands. Fire, excessive grazing, and improper road construction

Figure 14.—**An overstocked stand. Growth could be improved by thinning.**

accelerate erosion through removal of the vegetative cover. Timber should be logged and roads constructed according to approved methods.

CUTTING

Dense, overstocked stands (fig. 14) should be thinned or given improvement cutting to provide more favorable growing conditions for the remaining trees and to improve the stand. Thinning provides adequate growing space for selected trees left for future harvest. Usually the smaller trees are cut, but attention is given to uniform distribution (fig. 15). Improvement cutting removes overmatured, diseased, or otherwise unproductive trees so that the site can be more effectively used by high-quality trees left in the stand. Cutting in good, young second-growth generally should be limited to thinning. Pruning high-quality selected crop trees will improve the grade of lumber cut from them.

Woodlands containing mainly the poorer or undesirable species should be gradually converted to stands of the more valuable trees. Clearing and replanting are expensive, but the conversion can be accomplished over a long time by allowing the better trees to grow and reproduce.

Harvest cuttings should remove the mature trees, provide for natural reproduction of desirable species, and eliminate insect and disease hazards. The true firs should be harvested before the trees start to decay.

Young reproduction of true fir and Douglas-fir can be profitably managed for the production of Christmas trees. Intensive practices are needed to establish and maintain the largest number of good, marketable, well-branched trees for the annual Christmas trade. Thinning, weeding, and stump culture are important practices.

Recently a considerable income from woodlands in the Area has been obtained from the sale of Douglas-fir Christmas trees. A large percentage of the income of many farms is from the sale of Christmas trees. Thinnings of the right size can be utilized by sawmills specializing in the production of 2 x 4's. Smaller sized thinnings can be converted into posts and given preservative treatment. Treating plants are in the vicinity of Columbia Falls and Whitefish.

Properly managed woodlands have indirect values. In the Upper Flathead Valley Area, they protect the watershed for streams that provide most water for stock, irrigation, and domestic use. Woodlands also provide recreation for people and habitats for wildlife. The ponderosa pine type provides grazing for livestock. Trees

Figure 15.—**Ponderosa pine after thinning.**

protect farm homes from extremes of weather and the soil from wind erosion.

The characteristics of individual trees, their environment, and the wishes of the owner require that management be planned for each tract according to local conditions. Help can be obtained through the Soil Conservation District and from State and Federal agencies.

YIELDS

The yields to be expected from fully stocked stands at stated ages, for various forest trees when growing on soils of stated site indexes, are given in tables 6, 7, 8, and 9. The site index expresses soil quality in terms of the average total height of the dominant and codominant trees at a specified age. These are the larger trees, the crowns of which form the general level of the forest canopy and occasionally extend above it. Yields from understocked stands can be estimated by adjusting the values in these tables.

TABLE 6.—*Yields from unmanaged, fully stocked stands of ponderosa pine* [1]

[Board-feet per acre, Scribner rule, in trees 11.6 inches in diameter and larger]

Age	Site index						
	50	60	70	80	90	100	110
Years	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*
20							100
30					200	1, 000	2, 500
40			100	600	1, 900	4, 300	7, 500
50		100	700	2, 300	5, 000	9, 200	14, 000
60		600	2, 200	5, 100	9, 100	14, 800	21, 000
70	300	1, 800	4, 300	8, 500	13, 800	20, 500	27, 800
80	900	3, 500	7, 000	12, 200	18, 500	26, 000	34, 200
90	2, 000	5, 500	10, 000	16, 000	23, 000	31, 200	40, 200
100	3, 400	7, 800	13, 100	19, 700	27, 200	36, 100	45, 800
110	5, 000	10, 200	16, 200	23, 100	31, 100	40, 600	50, 800
120	7, 000	12, 500	19, 000	26, 200	34, 700	44, 600	55, 400
130	8, 900	14, 700	21, 500	29, 000	38, 000	48, 300	59, 600
140	10, 700	16, 700	23, 700	31, 500	40, 900	51, 700	63, 400
150	12, 400	18, 500	25, 700	33, 800	43, 600	54, 800	66, 900

[1] MEYER, WALTER H. YIELD OF EVEN-AGED STANDS OF PONDEROSA PINE. U.S. Dept. Agr., Tech. Bul. No. 630. 1938.

TABLE 7.—*Yields from unmanaged, fully stocked stands of lodgepole pine* [1]

[Cubic feet [2] per acre for trees 6 inches in diameter and larger and to a 3-inch top diameter]

Age	Site index					
	40	50	60	70	80	90
Years	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*
20						
30				148	425	700
40	76	200	410	945	1, 560	2, 080
50	400	630	1, 150	2, 050	2, 830	3, 570
60	835	1, 220	2, 000	3, 150	4, 200	4, 860
70	1, 250	1, 790	2, 700	4, 220	5, 300	5, 860
80	1, 710	2, 350	3, 400	5, 200	6, 200	6, 800
90	2, 100	2, 840	4, 060	5, 920	6, 920	7, 580
100	2, 400	3, 230	4, 600	6, 520	7, 550	8, 150
110	2, 700	3, 600	5, 130	7, 000	8, 060	8, 680
120	2, 900	3, 850	5, 600	7, 400	8, 450	9, 100
130	3, 120	4, 120	5, 900	7, 650	8, 750	9, 500
140	3, 320	4, 250	5, 910	7, 850	9, 000	9, 650
150	3, 440	4, 350	6, 070	8, 030	9, 100	9, 800

[1] Source of data was British Columbia Forest Service yield tables. 1947.

[2] Multiply by 6 to convert yield to approximate board-foot measure, and divide by 90 to convert yield to approximate cords.

TABLE 8.—*Yields from unmanaged, fully stocked stands of Western larch and of Douglas-fir* [1]

[Board-feet per acre, Scribner rule, in trees 13.0 inches in diameter and larger]

Age	Site index				
	30	40	50	60	70
Years	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*
40					500
50			100	1, 200	3, 400
60		40	1, 400	3, 800	8, 000
70		800	3, 200	7, 500	14, 500
80		1, 700	5, 400	12, 200	22, 900
90	70	2, 800	8, 100	18, 000	33, 900
100	300	4, 000	11, 200	25, 400	43, 500
110	600	5, 300	14, 900	33, 100	51, 400
120	1, 000	6, 800	19, 200	39, 800	58, 200
130	1, 500	8, 400	28, 100	45, 800	64, 300
140	2, 000	10, 200	29, 100	51, 200	69, 800
150	2, 600	12, 100	33, 800	56, 000	78, 800

[1] CUMMINGS, L. J. LARCH-DOUGLAS-FIR BOARD-FOOT YIELD TABLES. Applied forestry note No. 78, Northern Rocky Mountain Forest and Range Experiment Station, April 1937.

TABLE 9.—*Yields from unmanaged, second-growth stands of mixed conifers* [1]

[Board-feet per acre, Scribner rule, in trees 12.6 inches in diameter and larger]

Age	Site index					
	30	40	50	60	70	80
Years	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*	*Bd.-ft.*
40					400	1, 400
50			50	800	3, 300	7, 000
60		50	700	3, 700	10, 300	17, 800
70	100	600	2, 800	9, 700	21, 200	34, 000
80	500	2, 300	6, 500	17, 900	34, 600	50, 500
90	1, 600	4, 800	12, 100	28, 700	50, 300	65, 500
100	3, 300	8, 300	19, 200	40, 300	63, 200	79, 100
110	5, 400	12, 400	26, 100	50, 800	73, 400	88, 600
120	7, 600	16, 000	32, 200	59, 000	81, 000	96, 000
130	9, 500	18, 800	37, 000	65, 200	87, 000	No data
140	10, 900	21, 000	41, 000	70, 500	91, 600	No data
150	11, 700	22, 700	43, 800	74, 400	94, 800	No data

[1] Second-growth yields in the western white pine forest type, for stands consisting of western white pine, western larch, grand fir, hemlock, Douglas-fir, and other species. Data from: HAIG, IRVINE T. SECOND-GROWTH YIELD, STAND, AND VOLUME TABLE FOR THE WESTERN WHITE PINE TYPE. U.S. Dept. Agr. Tech. Bul. No. 323 1932.

Windbreaks

In parts of the Upper Flathead Valley Area, timber that grows on the sandier soils effectively controls wind erosion. Such stands of trees are also valuable as pro-

Figure 16.—A 3-row shelterbelt, 6 years old.

tection to farm homes, livestock, and crops. In nonforest areas, fields and farmsteads can be protected by planted belts of trees and shrubs. These plantings also provide food and habitat for wildlife. Chinese pheasants flock to tree plantings in winter storms.

Farmstead windbreaks should consist of three to eight rows of trees and shrubs and field shelterbelts of one to five rows (fig. 16). In cultivated fields, belts should be spaced from 20 to 40 rods apart to conserve moisture and prevent wind erosion. Windbreaks can be grown in most parts of the Upper Flathead Valley Area except on shallow, gravelly, rocky, poorly drained, or strongly alkaline soils.

The most effective arrangement of trees and shrubs for windbreaks is to plant the low-growing shrubs on the windward side, the intermediate trees next, and the tall-growing trees in the inner rows. Evergreens are usually planted in the leeward row to make the windbreak more effective in winter and to add color to the landscape.

The species of trees and shrubs that have been used for windbreaks are green ash, American elm, poplar, willow, ponderosa pine, Douglas-fir, blue spruce, juniper, hawthorn, caragana, chokecherry, plum, buffaloberry, honeysuckle, sand cherry, Nanking cherry, and Russian-olive. Willow and poplar should be used only where the planting can be irrigated or where the water table is near the surface.

The spacing between rows and between trees in the row is important in a windbreak. Spacing between rows should be enough to allow for cultivation with farm implements. A spacing of 12 to 16 feet is generally recommended. In the row, a spacing of 6 to 10 feet is suggested between the trees, and 3 to 4 feet between the shrubs. Minimum spacing for plants in the row should be used if the windbreak is narrow.

In the establishment of windbreaks or shelterbelts, advance preparation of the planting site is necessary for high survival and quick establishment of trees and shrubs. Land preparation also makes cultivation easier. Young trees cannot compete with weeds and grass, especially during the period of establishment. Consequently, it is necessary to prepare the planting area in advance. Cropland to be planted in trees should be clean fallowed for a year. Land in sod generally needs 2 years of fallow.

The control of weeds requires several cultivations a year for a period of 3 to 4 years. Trees that develop dense crowns will eventually shade out competing vegetation, but during the first several years, cultivation encourages vigorous growth of the trees. Along both sides of the windbreak a cultivated strip 12 feet wide should be maintained to control grass and weeds and to serve as a firebreak.

Fences should protect the planting from browsing, breakage, and trampling by livestock. The effectiveness of the planting is soon reduced if the lower branches are destroyed, as this encourages growth of grass and weeds. Rodents, insects, and diseases should also be controlled in a windbreak planting.

Wildlife

The environment of the Upper Flathead Valley Area is favorable for many kinds of animals, fish, and birds. The scattered and intermixed areas of forest, grass, cultivated fields, and water provide good food and cover for all kinds of wildlife.

The rivers, lakes, sloughs, and marshlands and the land bordering them are used by waterfowl during the migration and nesting season. They feed in nearby fields. The water areas are the habitat for shore birds, blackbirds, herons, and many other water-loving birds. Canada geese nest along the north end of Flathead Lake and along the Flathead River. The streams and marshes are habitats for beaver and muskrat. Trout is the main kind of fish in the valley. Some of the shallow lakes contain largemouth black bass, bluegill, and other warm-water fish. Some farm ponds have been stocked with trout.

Pheasants and Hungarian partridge are the main upland game birds. A few Franklin's grouse and ruffed grouse are in the forests. The large amount of woody cover along streams and in brushy areas provides winter cover for these larger birds. Grainfields near cover make the southern part of the valley a good habitat for pheasants.

White-tailed deer is the main big game animal of the valley. Other mammals are skunks, cottontail and snowshoe rabbits, ground squirrels, and pocket gophers.

Soils of the Upper Flathead Valley Area

This section contains a discussion of soil survey methods and detailed descriptions of the soils mapped in the Area.

Soil Survey Methods

The soil scientist who makes a soil survey digs or bores many holes to see what the soils are like. He measures steepness of slope and notes the lay of the land, the kind of rock outcrops, and the crops, trees, and other plants that grow on the soils. These and other observa-

tions help him learn the nature and extent of each kind of soil. He used an aerial photograph as a map and on it drew boundary lines between the different kinds of soils.

Soil scientists designate the soil layers, or horizons, with letters of the alphabet. The horizon at the surface, called the A horizon, has had soluble material and clay removed from it by water moving downward through the soil. Because organic matter is greatest at the surface, part of the A horizon is usually the darkest horizon of most soils. The A horizon is often divided into parts designated A_1, A_2, or A_3. The thickness of each soil horizon is measured.

The B horizon, which in many soils is the subsoil, is one in which the clay and other materials have accumulated. It may be divided into B_1, B_2, or B_3 layers. Material immediately under the B horizon, if it appears to be somewhat the same as that from which the soil was formed, is called the C horizon, or parent material.

The color of each horizon is given by descriptive words, as "very dark grayish brown," and by Munsell notations, as "10YR 3/2." Soil scientists use the Munsell notations to name color precisely and uniformly.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers. It is later checked by laboratory analyses. A loamy sand contains mostly the sand fraction, with just a small proportion of fine material. A clay contains enough fine material to make it plastic and sticky when moist. Most of the other textures lie between these two. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer.

Structure refers to the arrangement of the soil grains into lumps, granules, blocks, or other aggregates. If the horizon has a structure, we need to know the strength or grade (weak, moderate, or strong), the size (very fine, fine, medium, coarse, or very coarse), and shape (platy, prismatic, columnar, blocky, subangular blocky, granular, or crumb) of the aggregates. Soils without a definite structure are described as single grain if they are sand, or as massive if they are clay. Consistence refers to the feel of the soil and the ease with which a lump can be crushed.

The boundary that separates one horizon from another one is also given in soil descriptions. Boundaries are described as abrupt, clear, gradual, or diffuse, and smooth, wavy, irregular, or broken.

Description of the Soils

In this section each soil series is described and a definitely located profile typical of the series is given. The variations discussed after the profile description are for the series. Each mapping unit is then discussed, and any differences from the typical profile are pointed out. The present use and some of the hazards that limit use are also given for each mapping unit.

A list of mapping units and symbols is given in the Guide to Mapping Units and Capability Units at the end of the report. The approximate acreage of the soils mapped in the county is listed in table 10. The location and distribution of the soils are shown on the soil map in the back of the report.

TABLE 10.—*Approximate acreage and proportionate extent of soils*

Soil	Acres	Percent
Alluvial land, poorly drained	9,070	3.8
Alluvial land, well drained	415	.2
Banks loamy fine sand, 0 to 4 percent slopes	998	.4
Banks very fine sandy loam, 0 to 4 percent slopes	2,498	1.0
Birch fine sandy loam, 0 to 5 percent slopes	602	.3
Birch gravelly loam, 0 to 3 percent slopes	781	.3
Blanchard fine sand, 0 to 7 percent slopes	1,826	.8
Blanchard fine sand, 0 to 7 percent slopes, wind eroded	655	.3
Blanchard fine sand, 7 to 12 percent slopes	93	(1)
Blanchard fine sand, 7 to 12 percent slopes, wind eroded	1,997	.8
Blanchard fine sand, 12 to 35 percent slopes	1,210	.5
Blanchard fine sand, 12 to 35 percent slopes, wind eroded	810	.3
Blanchard loamy fine sand, 0 to 3 percent slopes	2,693	1.1
Blanchard loamy fine sand, 3 to 7 percent slopes	3,055	1.3
Blanchard loamy fine sand, 7 to 20 percent slopes	804	.3
Blanchard loamy fine sand, 20 to 45 percent slopes	220	.1
Blanchard very fine sandy loam, 0 to 7 percent slopes	126	.1
Blanchard very fine sandy loam, 7 to 12 percent slopes	138	.1
Blanchard very fine sandy loam, 12 to 20 percent slopes	175	.1
Blanchard very fine sandy loam, 20 to 45 percent slopes	553	0.2
Chamokane soils, 0 to 3 percent slopes	4,016	1.7
Chamokane soils, 3 to 7 percent slopes	906	.4
Chamokane and Banks soils, 0 to 4 percent slopes	1,381	.6
Corvallis silty clay loam, 0 to 3 percent slopes	2,428	1.0
Creston silt loam, 0 to 3 percent slopes	8,234	3.4
Creston silt loam, 3 to 7 percent slopes	1,091	.5
Creston silt loam, 7 to 12 percent slopes	102	(1)
Creston silt loam, 12 to 45 percent slopes	89	(1)
Demers-Kalispell silt loams, 0 to 3 percent slopes	435	.2
Demers-Kalispell silt loams, 3 to 7 percent slopes	985	.4
Demers-Kalispell silt loams, 7 to 25 percent slopes	68	(1)
Depew silty clay, 0 to 3 percent slopes	559	.2
Depew silty clay loam, 0 to 3 percent slopes	5,244	2.2
Depew silty clay loam, 3 to 7 percent slopes	50	(1)
Flathead fine sandy loam, 0 to 3 percent slopes	1,116	.5
Flathead fine sandy loam, 3 to 7 percent slopes	1,117	.5
Flathead fine sandy loam, 7 to 20 percent slopes	123	.1
Flathead sandy loam, 0 to 7 percent slopes	473	.2
Flathead very fine sandy loam, 0 to 3 percent slopes	1,565	.7
Flathead very fine sandy loam, 3 to 7 percent slopes	1,053	.4

See footnote at end of table.

TABLE 10.—*Approximate acreage and proportionate extent of soils*—Continued

Soil	Acres	Percent
Flathead-Creston loams, 0 to 3 percent slopes	1,747	0.7
Flathead-Mires loams, 0 to 3 percent slopes	701	.3
Half Moon silt loam, 0 to 3 percent slopes	6,092	2.6
Half Moon silt loam, 3 to 8 percent slopes	384	.2
Half Moon very fine sandy loam, 0 to 3 percent slopes	4,112	1.7
Half Moon very fine sandy loam, 3 to 7 percent slopes	446	.2
Half Moon very fine sandy loam, 7 to 12 percent slopes	41	(1)
Half Moon soils, 12 to 45 percent slopes	721	.3
Half Moon-Haskill complex, 0 to 3 percent slopes	1,260	.5
Half Moon-Haskill complex, 3 to 7 percent slopes	187	.1
Haskill fine sand, 0 to 7 percent slopes	180	.1
Haskill fine sand, 7 to 12 percent slopes	302	.1
Haskill fine sand, 12 to 45 percent slopes	1,798	.8
Haskill loamy fine sand, 0 to 7 percent slopes	362	.2
Haskill loamy fine sand, 7 to 20 percent slopes	67	(1)
Kalispell fine sandy loam, moderately deep over sand, 0 to 7 percent slopes	318	.1
Kalispell gravelly loam, moderately deep over gravel, 3 to 7 percent slopes	124	.1
Kalispell gravelly loam, moderately deep over gravel, 7 to 12 percent slopes	262	.1
Kalispell gravelly loam, moderately deep over gravel, 12 to 40 percent slopes	671	.3
Kalispell loam, 0 to 3 percent slopes	6,420	2.7
Kalispell loam, 0 to 3 percent slopes, wind eroded	350	.1
Kalispell loam, 3 to 7 percent slopes	1,132	.5
Kalispell loam, 3 to 7 percent slopes, wind eroded	197	.1
Kalispell loam, 7 to 12 percent slopes	274	.1
Kalispell loam, 12 to 25 percent slopes	66	(1)
Kalispell loam, moderately deep over gravel, 0 to 7 percent slopes	465	.2
Kalispell loam, moderately deep over gravel, 7 to 12 percent slopes	149	.1
Kalispell loam, moderately deep over sand, 0 to 3 percent slopes	465	.2
Kalispell loam, moderately deep over sand, 3 to 7 percent slopes	533	.2
Kalispell loam, moderately deep over sand, 7 to 12 percent slopes	79	(1)
Kalispell loam, moderately deep over sand, 12 to 40 percent slopes	423	.2
Kalispell silt loam, heavy subsoil, 0 to 3 percent slopes	696	.3
Kalispell silt loam, moderately deep over sand, 0 to 7 percent slopes	1,684	.7
Kalispell-Demers silt loams, 0 to 3 percent slopes	760	.3
Kalispell-Demers silt loams, 3 to 12 percent slopes	376	.2
Kalispell-Tuffit silt loams, 0 to 3 percent slopes	915	.4
Kalispell-Tuffit silt loams, 3 to 7 percent slopes	297	.1
Kalispell-Tuffit silt loams, 7 to 20 percent slopes	159	.1
Kiwanis fine sandy loam, 0 to 4 percent slopes	1,022	.4
Kiwanis loam, 0 to 3 percent slopes	2,265	1.0
Kiwanis loam, 3 to 9 percent slopes	83	(1)
Kiwanis-Birch fine sandy loams, 0 to 5 percent slopes	1,537	.6
Kiwanis-Birch loams, 0 to 4 percent slopes	895	.4
Krause gravelly loam, 0 to 3 percent slopes	155	.1
Krause gravelly loam, 3 to 7 percent slopes	2,701	1.1
Krause gravelly loam, 7 to 12 percent slopes	217	0.1
Krause gravelly loam, 12 to 35 percent slopes	1,273	.5
Made land	166	.1
McCaffery coarse sand, 0 to 5 percent slopes	744	.3
McCaffery loamy fine sand, 0 to 3 percent slopes	1,365	.6
McCaffery loamy fine sand, 3 to 7 percent slopes	67	(1)
McCaffery loamy fine sand, 7 to 12 percent slopes	76	(1)
McCaffery loamy fine sand, 12 to 30 percent slopes	122	.1
Mires gravelly loam, 0 to 3 percent slopes	4,141	1.7
Mires gravelly loam, 3 to 7 percent slopes	787	.3
Mires gravelly loam, 7 to 12 percent slopes	463	.2
Mires gravelly loam, 12 to 30 percent slopes	1,037	.4
Mires loam, 0 to 3 percent slopes	947	.4
Mires loam, 3 to 7 percent slopes	381	.2
Mires loam, 7 to 12 percent slopes	128	.1
Mountainous land	8,173	3.4
Muck and Peat	6,208	2.6
Prospect loam, 0 to 3 percent slopes	113	(1)
Prospect loam, 3 to 7 percent slopes	2,247	.9
Prospect loam, 7 to 12 percent slopes	1,060	.4
Prospect loam, 12 to 20 percent slopes	523	.2
Prospect stony loam, 3 to 7 percent slopes	307	.1
Prospect stony loam, 7 to 12 percent slopes	690	.3
Prospect stony loam, 12 to 20 percent slopes	1,088	.5
Prospect stony loam, 20 to 45 percent slopes	657	.3
Prospect-Tuffit silt loams, 0 to 3 percent slopes	26	(1)
Prospect-Tuffit silt loams, 3 to 7 percent slopes	396	.2
Prospect-Tuffit silt loams, 7 to 20 percent slopes	26	(1)
Radnor silt loam, 0 to 3 percent slopes	1,136	.5
Radnor silty clay loam, 0 to 3 percent slopes	1,485	.6
Riverwash	1,648	.7
Saline-alkali land	1,570	.7
Selle fine sandy loam, 0 to 3 percent slopes	583	.2
Selle fine sandy loam, 3 to 8 percent slopes	558	.2
Somers silt loam, 0 to 3 percent slopes	1,654	.7
Somers silt loam, 3 to 7 percent slopes	77	(1)
Somers silty clay, 0 to 4 percent slopes	276	.1
Somers silty clay loam, 0 to 3 percent slopes	3,507	1.5
Somers silty clay loam, 3 to 8 percent slopes	50	(1)
Stryker silt loam, 0 to 3 percent slopes	3,033	1.3
Stryker silt loam, sandy subsoil, 0 to 3 percent slopes	293	.1
Stryker silty clay loam, 0 to 3 percent slopes	1,295	.5
Swims silt loam, 0 to 3 percent slopes	2,555	1.1
Swims silt loam, 3 to 7 percent slopes	1,093	.5
Swims silty clay loam, 0 to 4 percent slopes	7,780	3.3
Tally, Blanchard, and Flathead soils, 0 to 3 percent slopes	2,182	.9
Tally, Blanchard, and Flathead soils, 0 to 3 percent slopes, wind eroded	641	.3
Tally, Blanchard, and Flathead soils, 3 to 7 percent slopes	945	.4
Tally, Blanchard, and Flathead soils, 3 to 7 percent slopes, wind eroded	237	.1
Tally, Blanchard, and Flathead soils, 7 to 12 percent slopes	166	.1
Tally, Blanchard, and Flathead soils, 7 to 12 percent slopes, wind eroded	56	(1)
Tally, Blanchard, and Flathead soils, 12 to 20 percent slopes	141	.1

See footnote at end of table.

TABLE 10.—*Approximate acreage and proportionate extent of soils*—Continued

Soil	Acres	Percent
Tuffit-Somers silty clay loams, 0 to 5 percent slopes	926	0. 4
Waits cobbly silt loam, fans, 0 to 3 percent slopes	1, 180	. 5
Waits cobbly silt loam, fans, 3 to 7 percent slopes	324	. 1
Waits silt loam, 0 to 7 percent slopes	229	. 1
Waits silt loam, fans, 0 to 4 percent slopes	259	. 1
Waits stony silt loam, 0 to 7 percent slopes	62	(1)
Waits stony silt loam, 7 to 12 percent slopes	4, 076	1. 7
Waits stony silt loam, 12 to 35 percent slopes	1, 907	. 8
Waits stony silt loam, fans, 0 to 7 percent slopes	1, 514	. 6
Waits and Krause stony loams, 0 to 7 percent slopes	323	. 1
Waits and Krause stony loams, 7 to 12 percent slopes	613	. 3
Waits and Krause stony loams, 12 to 40 percent slopes	9, 788	4. 1
Walters silt loam, 0 to 4 percent slopes	1, 676	. 7
Walters very fine sandy loam, 0 to 7 percent slopes	2, 325	1. 0
Whitefish cobbly silt loam, 0 to 7 percent slopes	1, 936	. 8
Whitefish cobbly silt loam, 7 to 12 percent slopes	5, 358	2. 2
Whitefish cobbly silt loam, 12 to 20 percent slopes	4, 371	1. 8
Whitefish cobbly silt loam, 20 to 45 percent slopes	2, 060	. 9
Whitefish gravelly silt loam, 0 to 7 percent slopes	1, 606	. 7
Whitefish gravelly silt loam, 7 to 12 percent slopes	236	. 1
Whitefish gravelly silt loam, 12 to 25 percent slopes	226	. 1
Whitefish silt loam, 0 to 3 percent slopes	503	. 2
Whitefish silt loam, 3 to 7 percent slopes	2, 236	. 9
Whitefish silt loam, 7 to 12 percent slopes	362	. 2
Whitefish silt loam, 12 to 35 percent slopes	107	(1)
Whitefish stony silt loam, 0 to 7 percent slopes	194	. 1
Whitefish stony silt loam, 7 to 12 percent slopes	117	(1)
Whitefish stony silt loam, 12 to 20 percent slopes	311	. 1
Whitefish stony silt loam, 20 to 45 percent slopes	6, 411	2. 7
Yeoman cobbly loam, moderately deep over sand, 0 to 3 percent slopes	1, 786	. 8
Yeoman cobbly loam, moderately deep over sand, 3 to 7 percent slopes	1, 053	. 4
Yeoman cobbly loam, moderately deep over sand, 7 to 12 percent slopes	208	. 1
Yeoman cobbly loam, moderately deep over sand, 12 to 25 percent slopes	120	. 1
Yeoman gravelly loam, 0 to 7 percent slopes	111	(1)
Yeoman gravelly loam, 7 to 12 percent slopes	113	(1)
Yeoman gravelly loam, 12 to 30 percent slopes	125	. 1
Yeoman gravelly loam, moderately deep over sand, 0 to 3 percent slopes	824	. 3
Yeoman gravelly loam, moderately deep over sand, 3 to 7 percent slopes	414	. 2
Yeoman gravelly loam, moderately deep over sand, 7 to 12 percent slopes	108	(1)
Yeoman gravelly loam, moderately deep over sand, 12 to 20 percent slopes	217	. 1
Yeoman gravelly loam, moderately deep over sand, 20 to 40 percent slopes	44	(1)
Yeoman loam, moderately deep over sand, 0 to 3 percent slopes	569	. 2
Yeoman loam, moderately deep over sand, 3 to 7 percent slopes	204	. 1
Yeoman loam, moderately deep over sand, 7 to 12 percent slopes	57	(1)
Yeoman silt loam, 0 to 7 percent slopes	208	. 1
Yeoman silt loam, 7 to 12 percent slopes	171	. 1
Yeoman silt loam, 12 to 20 percent slopes	208	. 1
Yeoman stony loam, 0 to 7 percent slopes	17	(1)
Yeoman stony loam, 7 to 12 percent slopes	70	(1)
Yeoman stony loam, 12 to 35 percent slopes	226	. 1
Yeoman stony loam, moderately deep over sand, 0 to 7 percent slopes	812	. 3
Yeoman stony loam, moderately deep over sand, 7 to 20 percent slopes	119	(1)
Yeoman stony loam, moderately deep over sand, 20 to 35 percent slopes	8	(1)
Miscellaneous land	10, 316	4. 3
Total	239, 360	100. 0

(1) Less than 0.1 percent.

Alluvial land

Alluvial land consists mainly of material that has been deposited recently near streams. It varies in color and texture. For the most part, this land occupies the immediate flood plains of larger streams and some isolated small areas and narrow strips along the meanders of streams. There are two mapping units.

Alluvial land, well drained (Ab).—This land type consists of sandy material on the flood plains of the larger streams. Some small areas occur as isolated spots and low ridges in the broader and higher bottom lands and as narrow strips along intermittent drains. This land type has irregular, low, hummocky relief, and, in many places, is traversed by partly filled, old stream channels in which water stands for short periods after floods. Between floods, these areas are well drained except in the lowest depressions. As a rule, the water table is seldom more than 4 to 6 feet below the surface.

In some areas of this land type, the surface soil and upper subsoil do not differ greatly from corresponding parts of the Kiwanis soils. However, the lower subsoil is more stratified and variable as a rule.

Typical profile:

1. 0 to 6 inches, grayish-brown (10YR 5/2) loam; soft granular or crumblike structure; friable and easily penetrated by plant roots, air, and moisture; moderate supply of organic matter; reaction about neutral but may be calcareous.
2. 6 to 20 inches, light brownish-gray or pale-brown (10YR 6/2 or 6/3) light loam or fine sandy loam; structureless; loose and friable when moist; usually calcareous; moderate available water-holding capacity.
3. 20 to 30 inches, gray to light-gray (10YR 5/1 to 7/1) stratified loamy sands and sands that may contain a sprinkling of gravel; fairly loose and only slightly coherent; calcareous; grades into loose sand or sand and gravel.

The color of the surface soil ranges from light gray to dark gray, depending on the amount of organic mat-

ter in the soil material. Adjacent to the streams, this land type is sandy throughout, faintly light colored, and differs little from Riverwash. Some of the higher areas are sandy and gravelly throughout and light colored below the 1- or 2-inch surface layer.

This land type originally supported a dense cover of coarse grasses and shrubs and sparse to moderately dense stands of evergreen and deciduous trees. In the higher areas, which are gravelly and sandy, the native vegetation is mainly ponderosa pine and a thin cover of grasses.

Alluvial land, well drained, is widely distributed but individual areas are small. Most of the acreage is left in native vegetation or is used as brushy pasture because of remoteness, irregular relief, flooding, and association with soils unsuited to farming. A few small areas with better soils adjacent to farmsteads are used for gardens or hay meadows. This land type is in capability unit VIs–1.

Alluvial land, poorly drained (Ac).—This land type differs from Alluvial land, well drained, in having poorer surface and internal drainage, darker surface soil as a whole, mottlings in the subsoil, and more uniformly loamy and silty surface soil and upper subsoil layers. It occupies nearly level areas, slight depressions, seepy spots next to higher land in the broad flood plains, and poorly drained, narrow valleys where stream channels are not well defined. It is subject to flooding. Some of the acreage is marshy and swampy.

The upper 2 feet of some areas included in this mapping unit do not differ greatly from the Corvallis soils, but the lower subsoil is more sandy.

Typical profile:

1. 0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; mellow and friable; well supplied with organic matter; neutral or calcareous.
2. 8 to 20 inches, grayish-brown (10YR 5/2) silt loam in the upper part; grades to light-brown (10YR 7/2) loam in the lower part; stained and mottled with yellow and brown; friable; calcareous.
3. 20 to 40 inches, light-gray (10YR 7/1), stratified loamy and sandy material that is more sandy with depth; mottled with yellow and brown; calcareous.

In areas adjacent to stream channels, the surface soil is sandy and light colored. In swales and marshes, a thin layer of muck or peat covers the surface, and the dark color extends to depths of 1 or 2 feet, where it grades to bluish gray mottled with brown.

The native vegetation of this land type is coarse grasses, rushes, sedges, and shrubs; evergreen and deciduous trees grow on the drier sites.

Except for small, included areas of soils that are well drained or only imperfectly drained, this land type is too wet for cultivation under natural conditions. Where it occurs on farms, it is used mainly for brushy pasture. It is in capability unit Vw–1.

Banks series

Soils of the Banks series are sandy for their entire depth. They occupy flood plains, mainly along the Flathead River. They have developed in recently deposited, very sandy alluvium. The native vegetation on Banks soils is a fair to good cover of coarse grasses, shrubs, and evergreen and deciduous trees.

Bank soils are subject to frequent flooding, but between floods they are well drained down to the water table. When the river is low, the water table is from 4 to 10 feet below the soil surface, depending on the elevation of soil above the river.

These soils have been stabilized only a short time and have weathered little since the parent material was deposited. Only a small amount of organic matter has accumulated in the surface soil. Vegetation has had little effect on color or other characteristics of these soils. All layers are calcareous.

The Banks and Chamokane soils and Riverwash occupy most of the low bottom lands along the Flathead River. These bottom lands extend from near Kalispell north to where the river leaves the mountains. The Banks soils have lighter colored surface soil and upper subsoil and sandier lower subsoil than the Chamokane soils. The soils occupy slightly higher elevations, are more stable, and have a better vegetative cover than Riverwash.

Typical profile (Banks loamy fine sand, in NE¼NW¼ sec. 35, T. 29 N., R. 21 W.):

A_1 0 to 3 inches, grayish-brown or brown to dark-brown (10YR 5/3.5, dry; 3/3, moist) loamy fine sand; weak, fine, crumb structure when moist, loose and single grained when dry; calcareous; boundary clear.

C_1 3 to 17 inches, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 4/2, moist) loamy fine sand; loose, single-grained; calcareous; boundary clear.

C_2 17 to 30 inches, same as horizon above, but sand is medium and coarse and 5 to 10 percent of material is fine and medium gravel.

The slight reddish or brownish cast throughout the Banks soils is due to the reddish and brownish argillite and quartzite sand grains. The second layer in the profile varies considerably in thickness in short distances and from area to area. The loose, underlying sand occurs at depths ranging from 8 to 20 inches.

Banks loamy fine sand, 0 to 4 percent slopes (Ba).—This soil has the profile described for the Banks series. The soil is suitable only for pasture, and very little of it is cultivated. It is somewhat unstable under native vegetation and is cut and scoured by overflows. If plowed, the soil is likely to be washed away in places. Pastures could be improved by thinning brush and trees. This soil is in capability unit VIs–1.

Banks very fine sandy loam, 0 to 4 percent slopes (Bb).—This soil is similar to Banks loamy fine sand, 0 to 4 percent slopes, except for texture of the surface soil. Most of this soil is subject to overflow from the river and is used for pasture. The amount and quality of forage could be improved by removing brush and thinning the trees.

Some of the higher lying, more stable acreage has been cleared and is used mainly for alfalfa, tame grasses, and garden vegetables. This soil is in capability unit VIs–1.

Birch series

In the Birch series are shallow, light-colored, sandy soils on high terraces and low bottoms. They are underlain by loose, gravelly sand at depths ranging from 10 to 24 inches. These soils have developed from alluvium that washed from mountains and from the older high terraces in which the larger streams are now entrenched

This alluvium was derived from quartzite, argillite, dolomite, and limestone.

The Birch soils have developed under forest and grass vegetation. The light-colored, leached surface soil without appreciable organic matter, however, is characteristic of forest soils. The dominant native vegetation is ponderosa pine, Douglas-fir, aspen, Oregon-grape, kinnikinnick, and several species of grass.

The Birch soils are rapidly permeable, excessively drained, droughty, and low in fertility. Runoff is low.

The Birch soils are lighter colored and have a less coherent and more gravelly subsoil than the associated Kiwanis soils. The Birch soils differ from the Banks soils mainly in having a loose, sandy subsoil. In places the Banks and Birch soils merge with a barely noticeable break in relief.

Typical profile (Birch fine sandy loam, in the SE¼ NE¼ sec. 9, T. 29 N., R. 21 W., on north side of road, 2,120 feet east of road intersection near the center of the section):

- A_0 1½ to 0 inch, very dark grayish-brown to very dark brown (10YR 3/2, dry; 2/2, moist) partly decomposed organic matter; matted plant roots in the lower half inch; slightly acid; boundary abrupt.
- A_2 0 to 6 inches, light brownish-gray to grayish-brown (10YR 6/2, dry; 5/2, moist) fine sandy loam; slightly darkened with organic matter in the upper ¼ to ½ inch; weak, coarse, platy structure; slightly hard when dry, very friable when moist; slightly acid; boundary clear.
- BC 6 to 14 inches, pale-brown to brown (10YR 6/3, dry; 5/3, moist) fine sandy loam; a few brown to dark-brown, medium-sized, firm lumps or spots of loam, which are the included B horizon; massive; soft and friable; reaction about neutral; boundary gradual.
- CD 14 to 22 inches, light-gray to pale-brown (10YR 7/1, dry; 6/3, moist) gravelly loamy sand; massive to single-grained; loose; reaction about neutral; boundary gradual.
- D 22 to 38 inches, loose sand and gravel; some gravel is thinly crusted with lime carbonate on the lower side.

In the Birch soils the loose gravel occurs at depths ranging from 10 to 24 inches. Gravel in various quantities occurs on the surface and in the upper part of the solum.

Birch fine sandy loam, 0 to 5 percent slopes (Bc).—This soil occurs mainly as widely scattered, small areas northeast of Kalispell. Its gently undulating relief is modified by shallow swales and low ridges that were caused by irregular deposition of parent material.

This soil is low in organic matter. The dry surface of the plowed soil is light brownish gray or very pale brown. A few small areas of cultivated soil on low ridges have been damaged by wind erosion. On ridge crests, several inches of the soil have been lost and subsoil gravel is brought to the surface by tillage.

About 40 percent of this soil is cultivated and used mainly for small grains and alfalfa. The cultivated acreage, as a rule, is used with the surrounding more productive soils that are better suited to farming. Some of the cultivated areas have been abandoned or retired to pasture. Cultivation of this soil is of doubtful value. Birch fine sandy loam, 0 to 5 percent slopes, is in capability class IVs–1.

Birch gravelly loam, 0 to 3 percent slopes (Bd).—This soil differs from Birch fine sandy loam, 0 to 5 percent slopes, in that 10 to 25 percent of the volume of the surface soil and upper subsoil is small- and medium-sized gravel. The soil occurs where there are outcrops of the extensive gravel beds that underlie low terraces nearly everywhere north of Kalispell at depths of 10 feet or more. Numerous small, oval-shaped areas and long narrow strips that are gravel bars within the Kiwanis and other Birch soils have slopes of as much as 5 percent.

About 25 percent of Birch gravelly loam, 0 to 3 percent slopes, has been cultivated, usually with the surrounding, better agricultural soils. Crop yields have been low and crop failure frequent.

Most of this Birch soil is now used for pasture. The vegetation on the old-field pastures consists mainly of annual weeds and grasses. The cover is thin, and the pastures have a very low carrying capacity. The rest of this soil has been logged for most of its timber and then used for grazing. Pasture on the virgin soil has a low carrying capacity. This soil is in capability unit VIs–1.

Blanchard series

Soils of the Blanchard series are shallow to moderately deep, dark-colored, and sandy. They occur in forest-grassland transition areas in the valley. They occupy high terraces and fans where wind has reworked the alluvial deposits, sorted out sand, and formed a wavy, dunelike topography before vegetation stabilized the area. The parent material was derived from gray, green, brown, and reddish argillite and quartzite containing enough dolomitic limestone to make the material calcareous.

Blanchard soils first developed under a predominantly grassy vegetation, which later contained trees. The vegetation now is grass and young second-growth ponderosa pine. When trees are cut, grasses spread to the cutover area.

The Blanchard series is composed of fine and very fine grayish soils that have little structure. The upper layers have been darkened by organic matter. The lower part of the profile is calcareous. The soils have a fairly low amount of organic matter and plant nutrients.

Blanchard soils, compared with the Haskill soils, have a thicker and darker A_1 horizon, but they lack the thick, weakly developed A_2 horizon of those soils. The parent material of the Blanchard soils was similar to that of the McCaffery soils but was somewhat finer.

Typical profile (Blanchard fine sand in a cultivated field in the SE¼NE¼ sec. 8, T. 29 N., R. 20 W., on south side of road and 850 feet west of road intersection):

- A_p 0 to 7 inches, dark-gray or dark grayish-brown to very dark grayish-brown (10YR 4/1.5, dry; 2.5/2, moist) fine sand; single grained and loose when dry; weak, granular, and very friable when moist; noncalcareous; boundary clear.
- AC 7 to 18 inches, light brownish-gray to brown (10YR 6/2, dry; 7.5YR 4/2, moist) fine sand; loose and single grained when dry or moist; slightly calcareous; boundary gradual.
- C 18 to 36 inches, gray (10YR 6/1.5, dry; 7.5YR 5/1.5, moist) fine sand; loose and single grained when dry or moist; calcareous, strong effervescence when hydrochloric acid is applied.

Surface layer of the Blanchard soils ranges from fine sand to very fine sandy loam, and subsoil from fine sand

to loamy fine sand. Free carbonates have been leached to depths ranging from 1 to 4 feet. Where leaching is deepest, the noncalcareous C horizon frequently contains firm, brown, nodular aggregates slightly higher in clay than the surrounding material. The brown hues are caused by reddish, sand-sized fragments of argillite rather than by an increase in iron oxide. The grayer hues prevail where the sand consists mainly of crystalline quartz. The surface layer may be calcareous in fields that have been severely damaged by wind erosion.

If used for crops, Blanchard soils should be protected from wind erosion by a growing crop or by crop residues.

Blanchard fine sand, 0 to 7 percent slopes (Be).—This soil is widely distributed over the area that extends from Creston to Columbia Falls and northward from Kalispell for a distance of 6 to 8 miles. North of Creston this soil occupies low ridges in association with the nearly level Creston and Flathead soils and the steeper phases of Blanchard soils. North of Kalispell it is associated mainly with the Kalispell and Tally soils and with other Blanchard soils.

About half this soil has never been cultivated and is used for pasture. Where cultivated, it is used mainly with other more stable and more productive soils for small grain, sweetclover, alfalfa, and other forage crops. Winter wheat is seldom grown on this and the associated very sandy soils. This soil is in capability unit IVes–1.

Blanchard fine sand, 0 to 7 percent slopes, wind eroded (Bf).—This soil has a profile like the typical profile, but most of the surface soil has been lost through wind erosion. Some of the calcareous subsoil is brought to the surface by tillage. This soil occurs mainly as small areas on low, dunelike ridges within large acreages of nearly level Flathead, Creston, and Kalispell soils that are usually farmed. The fields have a spotted pattern that is caused by light- and dark-colored soils.

This unstable, sandy soil is difficult to exclude from cultivation when it is closely associated with good farming soils. The larger, more continuous areas that were formerly in cultivation are now mostly used for pasture. This soil should be in permanent vegetation to prevent wind erosion. It is in capability unit IVes–1.

Blanchard fine sand, 7 to 12 percent slopes (Bg).—This soil has a profile similar to the one described but has a thinner surface soil. It is on the dissected edges of the terraces and fans, along small streams entrenched in the terraces, and in low dunelike areas where old alluvial sands were moved by wind before they were stabilized by vegetation.

Most of this soil is in grass and timber. The few areas that are cultivated have been seriously wind eroded and the surface soil is now brown or grayish brown. All cultivated areas are farmed with larger areas of more stable and more productive soils. This soil is in capability unit VIes–1.

Blanchard fine sand, 7 to 12 percent slopes, wind eroded (Bh).—Except for slopes, this soil is similar to Blanchard fine sand, 0 to 7 percent slopes, wind eroded. It consists of moderately rolling dunes north of Kalispell and moderately steep, sandy ridges north of Creston.

About 25 percent of the soil is in native vegetation, and 25 percent is cultivated. The rest was once cultivated, but it is now used for pasture. The virgin soil is severely eroded only where overgrazing and trampling by livestock have greatly reduced the grass cover. This soil should be in permanent grasses and used for pasture. It is in capabality unit VIes–1.

Blanchard fine sand, 12 to 35 percent slopes (Bk).—This soil has a profile similar to the one described, but the surface soil is slightly thinner. It is on sharply rolling dune areas and moderately steep edges of some of the terraces. Nearly all this soil is in native vegetation, and only occasional spots are affected by wind erosion. Cultivated areas were returned to grass before they were damaged by wind erosion. Consequently, most of this soil is used for pasture. Some small areas are idle, and others within cultivated fields are grazed only in winter. This soil is in capability unit VIes–1.

Blanchard fine sand, 12 to 35 percent slopes, wind eroded (Bm).—Wind erosion has completely removed the original surface soil from a large acreage of this soil, and has removed the surface soil and upper subsoil from smaller areas. This soil is characterized by numerous blowouts and light-colored spots and by dunelike topography. In the blowouts the calcareous subsoil, normally 16 to 24 inches below the surface, is exposed. The blown material has been spread over surrounding soils and mixed with them, or redeposited in the form of dunelike ridges 2 to 3 feet high. Only a small part of this soil still has its original profile, which is similar to the one described for the Blanchard series.

Most of this soil on slopes of 20 percent or less was formerly cultivated, and about one-half of it is still in cultivation. Because of steep slopes and hazard of wind erosion, this soil should be in permanent vegetation. It is in capability unit VIes–1.

Blanchard loamy fine sand, 0 to 3 percent slopes (Bn).—This soil is on the smoother parts of outwash fans and stream terraces, mainly east of the Flathead River and generally south of Columbia Falls. Its profile is similar to the one described for the Blanchard series. The surface soil, however, is loamy fine sand and is from 8 to 14 inches thick. This soil has a moderate amount of organic matter. The depth to free calcium carbonate ranges from 30 to 70 inches. The soil is most deeply leached in the general area south of Echo Lake.

Included with this soil are numerous small areas having slightly lighter colored surface soil. In these areas the stands of trees were thickest and the color of the surface soil is intermediate between that of grassland and forest soils.

Blanchard loamy fine sand, 0 to 3 percent slopes, is free of stone, and it can be cultivated within a wide moisture range. About 70 percent of the acreage in the Bad Rock community and about 50 percent in the vicinity of Echo Lake are farmed. This soil is in capability unit IVes–1.

Blanchard loamy fine sand, 3 to 7 percent slopes (Bo).—Except for slopes, this soil is similar to Blanchard loamy fine sand, 0 to 3 percent slopes. It occupies low hummocks and ridges, mainly in association with the more nearly level phase of Blanchard loamy fine sand. In some places, however, it occupies low ridges within areas of Mires gravelly loams; in others, it makes up very sandy areas within the Flathead soils.

Numerous light-colored spots occur on the surface of this soil, mainly on the low ridges and hummocks that have lost part of their surface layer through wind ero-

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sion. Tillage brings some of the light-colored subsoil to the surface.

All of the summer rain is absorbed by this soil. There is some runoff from the steeper slopes during spring thaws when the ground is frozen. This water collects in the low places or flows into the streams.

About half the acreage of this soil is cultivated, and the rest is in pasture. The cultivated soil is subject to moderate wind erosion, especially on the high spots. These spots can be protected by growing plants and by standing stubble or other crop residue. A good cover of permanent grass is the best protection. This soil is in capability unit IVes–1.

Blanchard loamy fine sand, 7 to 20 percent slopes (Bp).—This soil has slightly thinner and slightly lighter colored surface soil than Blanchard loamy fine sand, 0 to 3 percent slopes. It occupies small, widely scattered, low dunelike areas and moderately steep slopes near the edges of the terraces and alluvial fans. It occurs in association with the more nearly level phases of Blanchard loamy fine sand. The largest acreage is near Echo Lake.

Some of this soil is farmed with the surrounding soils, but it usually produces lower yields. When cultivated, this soil is subject to moderate wind erosion. It is best suited to permanent pasture. The soil is in capability unit VIes–1.

Blanchard loamy fine sand, 20 to 45 percent slopes (Br).—This soil occupies the steep terrace breaks and the short, steep slopes along small streams that are deeply entrenched in the terraces. A typical location is the steep, sandy slope, or escarpment, along the south side of Echo Lake. Except for slopes, this soil is similar to Blanchard loamy fine sand, 0 to 3 percent slopes.

This soil varies in texture, color, and thickness of the surface soil. It also varies in thickness and character of the underlying layers, but to less degree. Areas near the toe of slopes are thicker in places because of accumulated material. The surface soil in these areas is nearly black and as much as 2 feet thick. In some places the subsoil contains a small amount of gravel.

Blanchard loamy fine sand, 20 to 45 percent slopes, is too steep for cultivation. It has a mixed cover of grass, shrubs, and trees. It is used for pasture or is idle. It is in capability unit VIes–1.

Blanchard very fine sandy loam, 0 to 7 percent slopes (Bs).—This soil has a profile similar to the one described for the Blanchard series. The surface soil, however, is very fine sandy loam, and the second horizon is loamy fine sand. The parent material contains more silt and much more very fine sand than that of the Blanchard fine sands. This and other phases of Blanchard very fine sandy loam are a little more coherent in the surface soil and upper subsoil, have a higher moisture-holding capacity, and are more productive than the Blanchard fine sands.

This soil is on low, wind-formed ridges and small undulating areas on terraces and gently sloping terrace edges, mainly north and northwest of Kalispell. It is well drained, and all except the heaviest rainfall is absorbed readily. Small amounts of runoff occur when snow melts rapidly on frozen ground.

Most of this soil is cultivated or in tame hay. Wheat is the main cultivated crop. The soil needs protection at all times to prevent wind erosion and drifting. It is in capability class IIes–1.

Blanchard very fine sandy loam, 7 to 12 percent slopes (Bt).—This soil is similar to Blanchard very fine sandy loam, 0 to 7 percent slopes, except for slopes. It has been a little more affected by wind erosion, and it has a few more blowouts. It occupies rolling, wind-formed topography and moderately sloping edges of terraces.

Most of the trees have been cleared from this soil, and more than half the acreage is now in cultivation or was cultivated at some time. The uncultivated soil has been overgrazed for the most part and is slightly damaged by erosion, but less severely than the cultivated areas. This soil should be kept in grass and used for hay or pasture. It is in capability unit IVe–1.

Blanchard very fine sandy loam, 12 to 20 percent slopes (Bu).—This soil is similar to Blanchard very fine sandy loam, 0 to 7 percent slopes. It differs, however, in slope and in having variations in texture. It is on steep, dunelike areas or steeply sloping and dissected terrace edges. In places the lower part of the subsoil and underlying material consist of alternating strata of fine, medium, and coarse sand.

Nearly all of this soil is in native vegetation consisting of grasses and trees. The best use is for pasture. A few of the steep breaks between two terrace levels are mowed for hay and grazed in winter, or are left idle. This soil is in capability unit VIe–1.

Blanchard very fine sandy loam, 20 to 45 percent slopes (Bv).—This soil is mainly on the steep terrace edges and in narrow areas where small streams are deeply entrenched in the terraces. It is similar to the other phases of Blanchard very fine sandy loam. The parent material, unlike that of most of the other Blanchard soils, was modified little by the wind before the soil was formed. However, the soil has been reworked and mixed by water. It has been removed from some places and has accumulated in others because of soil creep. As a result, the dark surface soil ranges from 6 to 24 inches in thickness.

The vegetation consists mainly of brush and trees; grasses are in the more open spots. The soil is too steep for cultivation. When used for pasture, it provides a fair amount of grazing and browse. Much of the acreage is not used and is excellent as a wildlife habitat. The soil is in capability unit VIe–1.

Chamokane series

The Chamokane series consists of shallow, immature soils of the flood plains. They occur mainly along the Flathead River. These soils are subject to flooding in spring and early in summer. Light-colored alluvium is deposited on them each year.

The native vegetation is a moderate to dense stand of deciduous trees and brush and scattered coniferous trees. The more open areas have a good cover of grass. Bluegrass and several kinds of clover readily establish themselves where the trees are thinned or cut.

The surface soil of the Chamokane soils is grayish brown and sandy. It is underlain by pale-brown sandy material. Light brownish-gray fine sandy material occurs at an average depth of about 2 feet. These soils are generally slightly calcareous throughout.

These soils are slightly darker and finer textured than the Banks soils.

Typical profile (Chamokane fine sandy loam):

A_1 0 to 7 inches, grayish-brown to dark grayish-brown (10YR 5/2, dry; 4/2, moist) fine sandy loam; weak, medium, granular or crumb structure; soft when dry, very friable when moist; calcareous; boundary clear.

C_1 7 to 12 inches, pale-brown to brown (10YR 6/3, dry; 4.5/3, moist) fine sandy loam; massive to weak, crumb structure; soft when dry, very friable when moist; calcareous; boundary clear.

C_2 12 to 24 inches, very pale brown to pale-brown (10YR 7/3, dry; 6/3, moist) fine sandy loam; massive; soft when dry, very friable when moist; calcareous; boundary clear.

D 24 to 34 inches, light brownish-gray to pale-brown (10YR 6/2, dry; 6/3, moist), loose loamy fine sand stratified with fine and medium sand; calcareous.

The Chamokane soils vary somewhat in texture of the surface soil and subsoil and in the degree and kind of stratification of the substratum. The texture of the surface soil is dominantly fine sandy loam, but in some areas the surface soil is loam and silt loam and the upper subsoil is loam. The lower subsoil is more sandy than the upper subsoil and grades to loose, stratified sand or sand and gravel below a depth of 2 or 3 feet. A few small pieces of gravel are present throughout the soil.

Chamokane soils, 0 to 3 percent slopes (Ca).—These soils are on the nearly level flood plains that are crossed by numerous shallow flood channels. During heavy flooding some of the old channels are filled and new channels are opened. In addition, much soil is removed from areas not protected by vegetation and little fresh alluvium accumulates. Small areas of Banks soils, too small to be shown separately on the map, are included with some areas of this mapping unit.

Most of this mapping unit is covered by forest and brush. A few higher lying areas have been cleared for spring grains, chiefly oats, and for tame-grass hay. A large part of these soils is used as brushy or forest pasture. Some trees are cut to encourage the growth of the more desirable pasture grasses. Forage yields are fairly high in the cleared areas. Pasture is the best use of these soils because they are subject to erosion and loss of crops if cultivated. The soil is in capability unit IIe–2.

Chamokane soils, 3 to 7 percent slopes (Cb).—These soils have a profile similar to the one described for the series. The texture of the surface soil and the degree of stratification in the lower subsoil and substrata are more variable, however. The mapping unit is closely associated with Chamokane soils, 0 to 3 percent slopes, and with the Banks soils. The soils in this unit occupy areas where numerous deeply cut flood channels have formed low ridges and hummocks.

Little of this mapping unit has been cleared for cultivation, and only a very small part has been improved for pasture. It is in capability unit IIe–2.

Chamokane and Banks soils, 0 to 4 percent slopes (Cc).—This undifferentiated mapping unit consists of Chamokane soils and Banks loamy fine sand. These soils occur in such an intricate pattern that it was not feasible to map them separately. Both soils are described under their respective series.

The droughtiness of the Banks soils makes this unit generally unsuitable for farming. A small part is cultivated along with larger areas of more productive soils. The mapping unit is mostly in brushy pasture, and it is in capability unit IVs–1.

Corvallis series

The Corvallis series consists of deep, silty soils on flood plains. These soils have developed from alluvium derived from fine-textured quartzite, argillite, dolomite, and limestone that washed from glaciated uplands, high terraces, and eroding streambanks. The alluvium has accumulated in slack-water areas a short distance from streams. In addition, medium to moderately fine textured sediment has accumulated in partly filled, abandoned river channels to depths of 4 feet or more. The Corvallis soils have developed under a cover of coarse grass, shrubs, and trees.

These soils have restricted internal drainage because of their positions in relation to regional and local water tables. Nearly all areas have outlets through which surface water flows when floods subside. In spring, the water table drops rapidly to 2 or 3 feet below the surface. It drops more slowly through the growing season and is 4 to 6 feet below the surface by the end of summer.

The Corvallis soils are similar to Chamokane soils in topographic position and in color. However, the Corvallis soils have developed in silty sediment, and the Chamokane, in sandy material.

Typical profile (Corvallis silty clay loam, on south edge of road, at corner where south-going road turns west, in NE¼SW¼ sec. 20, T. 28 N., R. 20 W.):

A_1 0 to 8 inches, gray to dark-gray (10YR 5/1, dry; 4/1, moist), light silty clay loam; moderate, fine to coarse, granular structure; slightly hard when dry, friable when moist; a few fine pores; fine roots common; calcareous; boundary clear.

AC 8 to 11 inches, light-gray or gray to dark-gray (10YR 6/1, dry; 4/1, moist) silty clay loam; moderate, fine, subangular blocky and fine, granular structure; slightly hard when dry, slightly firm when moist; fine roots and fine pores common; calcareous; boundary clear.

C_1 11 to 20 inches, light-gray or very pale brown to grayish-brown or brown (10YR 7/2.5, dry; 5/2.5, moist) silt loam; a few, faint, fine, yellowish-brown mottles; massive in place but breaks to weak, fine, subangular blocks; slightly hard when dry, slightly firm when moist; a few, fine roots and fine pores; calcareous; boundary gradual.

C_2 20 to 40 inches, same color as horizon above; stratified silt loam and very fine sandy loam; common, faint, fine, yellowish mottles; massive, but the silt strata break to form slightly firm, subangular blocks that are slightly hard when dry and friable when moist; an occasional fine root; calcareous.

Corvallis soils have a moderate to good supply of organic matter in the surface soil. The amount gradually decreases with depth, and there is little below 18 to 24 inches. Some areas, however, are dark colored to depths of 2 or 3 feet, whereas others are light gray below a depth of 1 foot. These differences in color and depth of organic matter reflect the variable drainage conditions of the soils, and, to a certain degree, the character of the vegetation. These soils are usually darker to greater depths where the native vegetation was grass.

Corvallis silty clay loam, 0 to 3 percent slopes (Cd).—This is the only mapping unit of the Corvallis series in the Upper Flathead Valley Area. About 75 percent of this soil is in cultivation or seeded to hay and pasture grasses. The rest, including some fairly heavily wooded

areas, is used as unimproved pasture. Spring-seeded small grain (wheat, barley, and oats) and tame grasses are the principal crops. Some alfalfa is grown. The more open pastures contain considerable bluegrass and whiteclover.

This soil is excellent for grasses and spring-planted, early maturing small grain because it has a moderate to good supply of organic matter, is friable, and has abundant moisture within reach of plant roots. It warms somewhat later in spring than the better drained soils on the terraces and uplands. Late spring frosts may damage all but the hardy crops, because of the low position of this soil.

Much of this soil is drained by open ditches and improved natural drainage channels. Yields of all crops grown on this soil are among the highest for any soil in the Upper Flathead Valley Area. Because of the flooding hazard, this soil is in capability unit IIw–1.

Creston series

The Creston series consists of deep, dark, friable, silty soils on the broad terraces in the east-central part of the Upper Flathead Valley Area. The parent material is silty, medium-textured, water-sorted material on outwash fans and terraces that were formed by glacial streams when the glacier receded from the valley and mountain slopes. The native vegetation is a dense cover of tall grasses with a few scattered ponderosa pines.

The dark surface soil is, on the average, about 1 foot thick. It is underlain by a dark-brown layer, 6 to 10 inches thick. There is a rather abrupt transition between the dark-brown layer and the underlying light-colored, highly calcareous material.

The Creston soils are well drained. They absorb water readily and little runoff occurs. Small amounts of water may accumulate in low spots following heavy rains or rapid melting of snow. These soils have a good supply of organic matter. No injurious salts are present at any depth.

Creston soils differ from the Kalispell soils mainly in having a darker and slightly thicker surface soil and the horizon of calcium carbonate accumulation at greater depth. The silty lower subsoil and substratum in the Creston soils distinguish them from the Flathead and Blanchard soils, which have moderately sandy or sandy subsoils and substrata.

Typical profile (cultivated area of Creston silt loam on north side of road and about 740 feet west of road intersection in the SE¼SE¼ sec. 5, T. 28 N., R. 20 W.):

A_{1p} 0 to 12 inches, dark grayish-brown to very dark grayish-brown or very dark brown (10YR 3.5/2, dry; 2.5/2, moist) silt loam; weak, fine, granular or crumb structure; soft when dry, friable when moist; neutral; boundary clear.

B_2 12 to 18 inches, brown to dark-brown (7.5YR 4/2, dry; 3/3, moist) silt loam; weak, very coarse, prismatic structure; soft when dry, very friable when moist; neutral; boundary clear.

C_{ca} 18 to 33 inches, very pale brown to brown (10YR 7/3, dry; 5/3, moist) silt loam; weak, coarse, subangular blocky structure; soft when dry, very friable when moist; calcareous; accumulation of calcium carbonate in this horizon; boundary gradual.

C 33 to 42 inches, very pale brown to brown (10YR 7/3, dry; 5/3, moist) loam; massive; soft when dry, very friable when moist; calcareous; grades to stratified silt and sand.

The Creston soils are relatively uniform over much of their area. In places, however, they are leached of free carbonates to a depth of 20 to 26 inches and have a B_3 horizon. In some areas Creston soils intergrade to the Brocken soils (not mapped in this Area).

Creston silt loam, 0 to 3 percent slopes (Ce).—This is one of the most desirable soils in the Upper Flathead Valley Area for farming. It is nearly level and easily tilled. All is cultivated except a few small areas not easily reached. This soil is in a part of the valley that gets nearly the maximum rainfall. Because of ample moisture and a good distribution of summer rainfall, this soil produces nearly all crops suited to the Upper Flathead Valley Area. Winter wheat is the principal crop. This soil is in capability unit I–1.

Creston silt loam, 3 to 7 percent slopes (Cf).—This soil has irregular and moderate slopes. It occurs in close association with the nearly level Creston soil. Most of this soil occurs on small ridges within broad, nearly level terraces or along terrace edges and small drains crossing the terraces. In some small areas the surface soil is not quite so thick as that in the profile described for the Creston series. In places it was thinned by erosion. Most of this soil is cultivated; it is in capability unit IIe–1.

Creston silt loam, 7 to 12 percent slopes (Cg).—This soil is on the steeper terrace edges and short slopes along drainageways that cross the terraces. Although small in area, it is a prominent part of a landscape of nearly level soils.

This soil is slightly to moderately eroded. Erosion is the main problem in cultivated areas. Light-colored spots are common on some slopes where the subsoil has been mixed with the surface soil during cultivation. Most of this soil is farmed along with the more nearly level Creston soils. It is in capability unit IIIe–1.

Creston silt loam, 12 to 45 percent slopes (Ch).—This soil occupies moderately steep and steep breaks and edges of the terraces in association with other Creston soils. The surface layer is dark, but it is not so uniformly thick as that in the profile described as typical. In places the light-colored subsoil is only a few inches below the surface.

This soil is idle or in pastures consisting of native vegetation. Runoff is moderate to high after heavy rain, and cultivated areas are subject to considerable erosion. This soil is in capability unit VIe–1.

Demers-Kalispell complex

This complex consists of areas of Demers silt loam and Kalispell silt loam that occur in such an intricate pattern it was not feasible to map them separately. The acreage of each soil in the complex is about equal. The Demers member of the complex, a moderately deep, weakly solodized-Solonetz, contains salts that adversely affect the growth of plants. The Demers soil has developed from gray, green, and reddish argillite, quartzite, and dolomitic limestone. The native vegetation is a thin to moderately dense cover of grasses. These and saltgrass are on the strongly alkaline and saline spots. The other member of the complex, Kalispell silt loam, is described under the Kalispell series.

The Demers soil has a brownish silt loam surface soil and a brownish claypan subsoil with a blocky structure.

It is underlain at a depth of about 2 feet by stratified sandy material.

Demers silt loam differs from Tuffit silt loam mainly in having slightly lighter colored surface and subsoil horizons and sandier substrata below depths of 20 to 30 inches.

The Demers soil is characterized by occasional saline spots and numerous places where wind has removed the friable surface soil and left only a thin light-gray, platy crust covering the claypan. The claypan is very slowly permeable; it can be completely moistened only through prolonged soaking. The claypan checks the downward movement of water; consequently, the surface soil may be saturated for several days after heavy rains. The soil can hold large quantities of moisture for plants, but the clayey subsoil releases it very slowly. As a result, when moisture in the surface soil is used up, nearly all crops are damaged through lack of moisture, and yields are reduced. Free salts, injurious to most crops, are in the lower part of the subsoil in most areas and near the surface in some.

The use of either soil in this mapping unit must be adjusted to take into account the suitability of the other soil.

A typial profile (Demers silt loam, cultivated, in SE¼SE¼ sec. 29, T. 28 N., R. 21 W.):

A_{1p} 0 to 7 inches, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 4/2, moist) silt loam; weak, fine, granular structure; soft when dry, very friable when moist; about neutral; boundary abrupt.

B_2 7 to 14 inches, very pale brown to brown (10YR 7/3, dry; 4/2.5, moist) silty clay loam; strong, coarse, prismatic and medium, blocky structure; very hard when dry, firm when moist; alkaline reaction; boundary clear.

C_{ca} 14 to 24 inches, very pale brown to brown (10YR 7/3, dry; 5/3, moist) silt loam; massive in place but breaks out in medium, subangular blocks; soft when dry, friable when moist; strongly calcareous; boundary clear.

D 24 inches +, light-gray to dark grayish-brown (10YR 7/2, dry; 4/2, moist) fine sand; thinly stratified with loam and fine sandy loam; calcareous.

The Demers soils vary in thickness of surface soil, in depth to the stratified sandy substratum, and in the number of eroded and saline spots. A thin, leached, light-gray A_2 horizon occurs in places, but it is not readily discernible in all spots.

Demers-Kalispell silt loams, 0 to 3 percent slopes (Da).—This mapping unit is mainly on the high terraces south of Kalispell. Nearly all of it is cultivated and used mainly for winter wheat alternated with summer fallow. Wheat develops normally on the friable soil, but it grows unevenly where the claypan subsoil is present. Where tillage is largely in the clay layer, wheat grows poorly and yields are very low, or the crop is a complete failure. The complex is best suited to grasses. It is in capability unit VIs–2.

Demers-Kalispell silt loams, 3 to 7 percent slopes (Db).—About half the acreage in this mapping unit is cultivated and used mainly for wheat and barley. The rest is in pastures, most of which are overgrazed. Cultivated land and pastures are subject to wind and water erosion.

In addition to the Demers and Kalispell soils, this mapping unit includes small areas of friable soils that contain free calcium carbonate and possibly other salts at or near the surface. The soils high in lime are usually on ridge points and narrow ridge crests. In this position the soils are naturally thin and subject to the most active wind and water erosion. Some of the acreage also includes definitely salty soils. These soils occupy narrow, intermittent swales that may hold water for short periods.

This mapping unit is suited best to grasses. It is in capability unit VIs–2.

Demers-Kalispell silt loams, 7 to 25 percent slopes (Dc).—This mapping unit is on sloping terrace edges. All of it is in pasture and idle areas. It is not suitable for cultivation because of unfavorable slopes and the risk of erosion. The carrying capacity for livestock is low.

The soils are variable and include some small spots and narrow strips of moderately to strongly saline soils. In places the soils are thin, light-colored, and calcareous in all layers.

This mapping unit is in capability unit VIs–2.

Depew series

The Depew series consists of deep, light-colored, moderately well drained, moderately fine textured soils. These soils occur in the northern part of the Upper Flathead Valley Area. They have developed in silty to clayey alluvium deposited by glacial streams or have accumulated in temporary glacial lakes as the glacier receded from the Upper Flathead Valley Area. The native vegetation is a mixture of Douglas-fir, larch, and lodgepole pine and some ponderosa pine. In the open forests and cutover areas, the understory is Oregon-grape, kinnikinnick, and a variety of other shrubs.

The soils of this series are clayey throughout the profile. The surface soil is about 10 inches thick and has a definite blocky structure that is very hard when dry. A zone of lime accumulation is at a depth of about 2 feet.

Although the Depew soils have slow runoff and permeability, they are poorly drained only where they grade to poorly drained soils.

The Depew soils are less permeable, less well drained, and of finer texture, especially in the subsoil, than the Half Moon soils.

Typical profile (Depew silty clay, 0.2 mile west and 0.2 mile north of the southeast corner of sec. 2, T. 29 N., R. 22 W.):

A_p 0 to 8 inches, light-gray to grayish-brown (10YR 6.5/1.5, dry; 4.5/2, moist) silty clay; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; boundary abrupt.

A_2B 8 to 11 inches, very pale brown to brown (10YR 7/3, dry; 5/3, moist) silty clay loam; weak, subangular blocky structure; light-gray (dry) A_2 coating on peds; hard when dry, firm when moist; medium acid; boundary clear.

B_2 11 to 20 inches, pale-brown to brown (10YR 6/3, dry; 5/3, moist) silty clay; moderate, medium, blocky structure; patchy, dark coating and thin, patchy clay films on vertical faces of peds; very hard when dry, firm when moist; slightly acid; boundary gradual.

B_{2ca} 20 to 24 inches, very pale brown to brown (10YR 7/3, dry; 5/3, moist) silty clay; weak to moderate, blocky and subangular blocky structure; hard when dry, firm when moist; slightly calcareous; has a few fine white spots and threads of free calcium carbonate; boundary clear.

C_{ca} 24 to 30 inches, white to light brownish-gray (10YR 8/2, dry; 6/2, moist) silty clay loam; pale-brown (dry);

irregular spots or stain and white threads, streaks, and coating of calcium carbonate; weak, moderate, horizontal bedding or stratification and weak, vertical cracking produce a weak, moderate, blocky structure; hard when dry, firm when moist; boundary clear.

C_1 30 to 42 inches, light-gray and brown or pale-brown and brown (10YR 7/2 and 6/3, dry; 6/3 and 5/3, moist), varied silty clay loam; hard when dry, firm when moist; calcareous; boundary gradual.

C_2 42 to 54 inches, very pale brown to pink (10YR 7/3, dry; 7.5YR 7/4, moist) silty clay loam with thin strata of fine sand at depths of 48 and 54 inches that contained free water when examined; calcareous; boundary gradual.

C_3 54 to 60 inches +, thinly stratified, calcareous silt loam; color same as in horizon above.

Depending on natural drainage, Depew soils vary greatly in the depth to free lime carbonates and in the grade of structure. Lime is leached to the greatest depth and structure is strongest in the better drained places. Free lime occurs at depths of 12 to 30 inches.

Depew silty clay, 0 to 3 percent slopes (Dd).—This soil is mainly on the broad, nearly flat terraces east of the Stillwater River, 6 to 8 miles south of Whitefish. Where the surface layer is thin, it has been mixed with some of the more compact upper subsoil. Fields on which this mixing has occurred have a cloddy, rough surface and are difficult to prepare properly for seeding. This condition, together with slower drainage, the likelihood of temporary ponding in places, and slow warming in spring, make this soil less desirable for farming than Depew silty clay loam, 0 to 3 percent slopes.

About 20 percent of this soil is cleared; it is used mainly for grass, spring grain, and alfalfa. The rest is mainly in cutover and second-growth forest. This soil is in capability unit IVs–2.

Depew silty clay loam, 0 to 3 percent slopes (De).—Except for texture of the surface soil, this soil has a profile similar to the one described. It is desirable for farming because it has smooth relief, occurs in fairly large areas, and is friable and easily tilled. Yields are poor the first few years after clearing because organic matter and nitrogen are low.

About 40 percent of this soil is cultivated, and 20 percent is in brushy and partly wooded pasture. The rest is mainly in cutover and second-growth forest. This soil is in capability unit IIIs–3.

Depew silty clay loam, 3 to 7 percent slopes (Df).—This soil is on the sloping edges of the terraces, where it is associated with large areas of Depew silty clay loam, 0 to 3 percent slopes. About 20 percent of the acreage is in fields and cultivated with other soils. The rest is used as wooded pasture or is in cutover woodland. The soil is in capability unit IIIs–3.

Flathead series

The Flathead series consists of deep, dark, well-drained, moderately sandy soils. These soils are mostly on the east side of the valley—the largest area is northeast of Kalispell. The parent material is stream-terrace alluvium that originated mainly from gray, green, and reddish argillite, quartzite, and dolomitic limestone of the Belt formation. The soils developed under tall grass. Scattered trees and small clumps of ponderosa pine are common to areas of these soils.

The Flathead soils have a dark surface soil, 1 to 2 feet thick, and a nearly massive, brown, sandy subsoil. The brown, sandy parent material is calcareous and is about 40 inches below the surface.

Runoff is very slow, as nearly all rain is absorbed. Permeability is moderately rapid.

Thicker surface soil, coarser textured and thicker subsoil, and the lack of marked accumulations of calcium carbonate in the Flathead soils distinguish them from the Creston soils. The Flathead soils have a darker and thicker surface soil than the Tally soils, and they are finer textured than the Blanchard.

Typical profile (Flathead fine sandy loam):

A_{11} 0 to 12 inches, very dark grayish-brown to very dark brown or black (10YR 3/1.5, dry; 2/1.5, moist) fine sandy loam; moderate, fine, granular structure; soft when dry, very friable when moist; about neutral; boundary clear.

A_{12} 12 to 24 inches, very dark grayish-brown to very dark brown (10YR 3/2, dry; 2/2, moist) fine sandy loam; weak, very coarse prisms that readily separate into moderate, fine, granular structure; soft when dry, very friable when moist; about neutral; boundary clear.

B_2 24 to 34 inches, brown to dark reddish-brown (7.5YR 4/2, dry; 5YR 3/2, moist) fine sandy loam; weak, coarse prisms that separate into weak, medium, subangular blocky structure; soft when dry, very friable when moist; about neutral; boundary gradual.

B_3 34 to 44 inches, pale-brown to brown or dark-brown (10YR 6/3, dry; 7.5YR 4/3, moist), light fine sandy loam or loamy fine sand; massive in place but breaks into weak, coarse, subangular blocky structure; soft and nearly single grained when dry, very friable when moist; slightly alkaline; boundary clear.

C 44 to 54 inches +, pale-brown to brown (10YR 6/3, dry; 5/3, moist) loamy fine sand; massive or single-grained; soft and very friable; moderately calcareous; spots of lime accumulation weakly cement the sand and form weak, fine, subangular, blocklike lumps that are slightly hard when dry and slightly firm when moist.

In some areas of Flathead soils, the surface soil and subsoil are somewhat thinner than described. The subsoil in many places grades at a depth of about 36 inches to noncalcareous loamy sand, and at a depth of about 45 inches, to weakly calcareous sand without segregated lime. Some areas have a sprinkling of small gravel, and others have stratified sand and gravel below a depth of about 4 feet.

Flathead fine sandy loam, 0 to 3 percent slopes (Fa).—This soil occurs mainly between Creston and Bigfork. Most of the acreage is cultivated, but about 10 percent is in native pasture. This soil is desirable for farming because it has nearly level relief, contains a large amount of organic matter, and has good capacity to hold moisture for plants. It is also easily tilled. It is in capability unit IIes–1.

Flathead fine sandy loam, 3 to 7 percent slopes (Fb).—This soil occurs mainly on parts of terraces where wind drifted the old alluvium into low ridges and hummocks before it had been stabilized by vegetation. It is also along terrace slopes where drainage channels have formed. Most of this land is cultivated and is in capability unit IIes–1.

Flathead fine sandy loam, 7 to 20 percent slopes (Fc).—This soil is on moderately steep terrace edges and low, rolling, dunelike areas within the more nearly level phases of Flathead fine sandy loam. In places the surface soil has been thinned by wind erosion.

About one-third of this soil is cultivated, and the rest is in native grasses. Because of steep slopes and the hazard of wind erosion, this soil is suited best to grasses used as hay. It is in capability unit IVe-1.

Flathead sandy loam, 0 to 7 percent slopes (Fd).—This soil contains more coarse and medium sand than any of the other Flathead soils. It is one of the very dark soils that are on sandy terraces north of Creston. The surface soil is slightly thinner than that of the profile described. Most of this soil is cultivated. It is in capability unit IIes-1.

Flathead very fine sandy loam, 0 to 3 percent slopes (Fe).—This soil is on nearly level, smooth to slightly undulating alluvial fans and stream terraces. The irregular surface was caused partly by drifting and partly by irregular accumulation of old alluvium before the deposits were stabilized by vegetation. This is one of the most productive soils in the valley, and nearly all of it is in cultivation. It is in capability unit I-1.

Flathead very fine sandy loam, 3 to 7 percent slopes (Ff).—This soil occupies the more sloping parts of terraces and is on areas of low irregular relief where ridges are higher than is typical of Flathead very fine sandy loam, 0 to 3 percent slopes. Most of this soil is cultivated. Wind erosion is the main problem. The soil is in capability unit IIe-1.

Flathead-Creston loams, 0 to 3 percent slopes (Fg).—This complex consists of Flathead, Creston, and Mires soils too intricately mixed to be mapped separately. It occurs near the town of LaSalle in a nearly level area that is underlain by coarse gravelly substrata at depths of 2 to 5 feet. Mapped in this complex are areas where the gravel is normally below a depth of 3 feet and the subsoil is loamy to moderately sandy.

The Flathead soil in this complex is similar to Flathead very fine sandy loam, 0 to 3 percent slopes. The Creston soil is similar to Creston silt loam, 0 to 3 percent slopes, but is a little more sandy in the lower subsoil. The Mires soil is slightly thicker and less gravelly than Mires gravelly loam, 0 to 3 percent slopes, but has the same coarse gravelly sand substrata.

This complex has about the same use and management, productivity, and moisture-holding capacity as Flathead very fine sandy loam, 0 to 3 percent slopes. Most of this complex is in cultivation and is in capability unit IIes-1.

Flathead-Mires loams, 0 to 3 percent slopes (Fh).—This complex and the Flathead-Creston loams, 0 to 3 percent slopes, are in the same general area. Where the soils in this area have variable loose, gravelly, and moderately sandy subsoil, they are mapped in this complex. The Flathead and Creston soils in this complex are fairly typical of the Flathead and Creston soils described in this report.

The moderate depth of these soils over loose gravel limits the water-holding capacity. Crop yields are reduced somewhat below that of the typical Flathead soils in dry seasons. This complex is in capability unit IIIs-1.

Half Moon series

The Half Moon series consists of deep, light-colored, medium-textured soils. These soils have developed in calcareous, light-colored, thinly stratified silt and fine sand deposited by glacial streams and in temporary lakes that were formed when the glacier left the Upper Flathead Valley Area. Half Moon soils occupy broad, nearly level terraces in the northern and southeastern parts of the Upper Flathead Valley Area. The Half Moon soils developed in well-drained areas under coniferous trees mixed with a few deciduous trees and a ground cover of shrubs, bracken fern, and Oregon-grape. In the more open places the ground cover also includes kinnikinnick and coarse grasses.

These soils have a thin, light-colored surface horizon, about 4 inches thick. Below this is a light-colored transitional horizon, 6 to 12 inches thick, that has silt loam to loam texture. The moderately developed subsoil, or B horizon, about 8 to 14 inches thick, is brownish and has a blocky structure. A zone of moderate lime accumulation is at the base of the subsoil and upper part of the parent material.

Half Moon soils contain less clay than the Depew soils, and they have a more permeable subsoil. They do not have the large stones and boulders and the coarse fragments that are in the closely resembling Whitefish soils.

Typical profile (Half Moon silt loam, about 700 feet northwest of the quarter-section corner on the east side of sec. 6, T. 30 N., R. 22 W., on powerline right-of-way, about 200 feet south of its crossing of an abandoned highway):

A_0 2 to 0 inches, forest litter consisting of needles, leaves, and twigs; upper part loose and moderately decomposed, lower half inch matted with roots and dark brown when moist; boundary abrupt.

A_2 0 to 4 inches, white to light brownish-gray (10YR 8/2, dry; 6/2.5, moist) silt loam; moderate, thin, platy and weak, very fine, granular structure; slightly hard when dry, very friable when moist; many fine pores, roots, and root channels; pH 5.0; boundary clear.

A_2–B 4 to 7 inches, white and light-gray to light brownish-gray and grayish-brown (mixed 10YR 8/2 and 7/2, dry; 6/2 and 5/2.5, moist) silt loam; weak, thick, platy and moderate, medium, subangular blocky structure; thick coating of A_2 material on exterior of peds and remnants of B_2 material in interior of peds; moderately hard when dry, friable when moist; many fine pores, roots, and root channels; pH 6.5; boundary clear.

B_2–A_2 7 to 11 inches, very pale brown and white to brown and grayish-brown (mixed 10YR 7/3 and 8/2, dry; 5/3 and 5/2.5, moist), heavy silt loam; strong, medium, subangular blocky structure; thin coating of A_2 material on B_2 peds; hard when dry, firm when moist; fine pores, fine roots, and root channels common; pH 6.8; boundary abrupt.

B_{21} 11 to 16 inches, very pale brown and light yellowish-brown to brown and yellowish-brown (mixed 10YR 7/3 and 6/4, dry; 4/3 and 5/4, moist), light silty clay loam; moderate, medium, blocky and subangular blocky structure; hard when dry, firm when moist; many fine pores; fine roots and root channels common; thin, patchy coating of clay on some ped faces and a thick coating of clay in root channels; pH 7.0; boundary clear.

B_{22} 16 to 22 inches, brown and pale-brown to dark-brown (mixed 10YR 5/3 and 6/3, dry; 4/3 and 5/3, moist), light silty clay loam; moderate, coarse, subangular blocky structure; hard when dry, firm when moist; medium fine pores, roots, and root channels common; thin to moderately thick, patchy coating of clay on many ped surfaces and in root channels; pH 7.7, weak effervescence on a few, fine, white spots in lower inch; boundary irregular.

B_{ca} 22 to 26 inches, pale-brown with brown spots, and brown with dark-brown spots (10YR 6/3, dry; 5.5/3, moist) silt loam; weak, coarse, subangular

blocky structure; slightly hard when dry, firm when moist; few, fine pores and common, fine roots and root channels; calcareous, with common, soft, white spots of segregated calcium carbonate; pH 7.7; boundary irregular.

C_{ca} 26 to 31 inches, pale-brown to brown (10YR 6/3, dry; 5/3, with spots of 4.5/3, moist) silt loam; distinct horizontal cleavage; weak vertical breakage to medium, subangular blocks; slightly hard when dry, firm when moist; few, fine pores and root channels but no live roots observed; calcareous, and has fine threads, spots, and seams of segregated calcium carbonate; pH 8.0; boundary abrupt.

C_1 31 to 41 inches, very pale brown to brown (10YR 7/3, dry; 5/3, moist) very fine sandy loam containing thin lenses or strata of silt; massive; soft when dry, very friable when moist; calcareous, and has a few, fine, white spots of lime; pH 8.0; boundary abrupt.

C_2 41 to 48 inches +, white to light brownish-gray (10YR 8/2, dry; 6/2, moist), thinly stratified or varved silty alluvium; massive; firm when dry and moist; calcareous.

The thickness of the main horizons and of the transitional layers is variable in Half Moon soils. The texture of the surface soil ranges from very fine sandy loam to heavy silt loam. The subsoil ranges from loam to light silty clay loam, depending on the way the parent alluvium was stratified and on the amount of clay movement there has been in the profile.

Half Moon silt loam, 0 to 3 percent slopes (Ha).—This soil is almost uniformly silty throughout the profile and parent material, or to depths of 5 feet or more. In some places a small amount of water-rounded gravel and thin lenses of gravelly silt loam or gravelly clay loam are in the upper 2 feet.

This soil is well suited to farming, but much of the acreage is in cutover and second-growth forest. A small part is in virgin forest, mainly Douglas-fir and larch. Along the Stillwater River a large acreage is used mainly for small grains and hay. A few small areas have been cleared in other sections and are in vegetables for home use, in small grain and hay for workstock, and in winter feed for the family milk cow. Strawberries and raspberries grown in small patches produce fruit for home use and for sale to nearby towns and villages and to summer residents in the Flathead Lake resort area. This soil is in capability unit IIs–1.

Half Moon silt loam, 3 to 8 percent slopes (Hb).—This soil is on the gently sloping edges of terraces and along some of the drains that cross terraces.

Little or none of this soil is cultivated. It is suitable for cultivation if protected from water and soil erosion. It is in capability unit IIIe–2.

Half Moon very fine sandy loam, 0 to 3 percent slopes (Hc).—This soil is slightly sandier than the Half Moon silt loams. The surface soil is a very fine sandy loam, and the subsoil in places is a light clay loam. The parent material consists of stratified sand and silt.

Eighty percent or more of this soil is in second-growth and cutover forest and brushy pasture. New farms and the expanding operations on other farms are bringing more of this soil into cultivation each year. The soil is suitable for cultivation, and, after a few years of development, it is fairly productive. This soil is in capability unit IIs–1.

Half Moon very fine sandy loam, 3 to 7 percent slopes (Hd).—This soil is in widely separated small areas on terrace edges and along small streams. A small acreage has slopes of 8 to 10 percent.

Only about 10 percent of this soil is cultivated. The rest is in cutover and second-growth timber and brushy pasture. When cleared, the stronger slopes will erode unless runoff is controlled. This soil is in capability unit IIIe–2.

Half Moon very fine sandy loam, 7 to 12 percent slopes (He).—This soil is in a few small, widely scattered areas. Under native forest some runoff occurs during heavy rain and rapid melting of snow. As a result, less water enters the soil, free lime carbonates are leached to less depth, and the soil horizons are thinner than in Half Moon very fine sandy loam, 0 to 3 percent slopes. In addition, this soil is shallower over unweathered parent material.

Most of this soil is in forest. Except for slope, this soil is about as suitable for cultivation as the less steep phases of Half Moon very fine sandy loam. Sheet erosion, however, would be a serious problem in farming the steeper slopes. This soil should be left in forest or used only as pasture. It is in capability unit VIe–1.

Half Moon soils, 12 to 45 percent slopes (Hf).—This mapping unit consists of all Half Moon soils on slopes of more than 12 percent; the predominant slopes range from 20 to 40 percent. These soils differ from Half Moon soils on gentler slopes in that texture of the surface soil and the depth to underlying unweathered material are extremely variable. The texture of the surface soil ranges from loamy fine sand to silt loam, but the predominant textures are loam and fine sandy loam. On steep slopes, the horizons are thin, and in places, not well defined. The stratified sandy and silty substratum is at depths ranging from 16 to 30 inches. In a few places, on steeper slopes where these soils are associated with the Depew soils, the silty clay loam or silty clay subsoil horizons are much like the corresponding horizons in the Depew soils.

The soils of this mapping unit occupy the steep edges of terraces where the break is from one terrace to another and to the bottom lands along the larger streams. Small areas are also along the small, deeply incised drainageways that cross the terraces or originate within them.

None of the acreage in this mapping unit is cultivated. Most of it is in second-growth forest, and some is wooded and in brushy pasture. Slopes stronger than 20 percent should be left in forest; the rest can safely be improved for pasture. This mapping unit is in capability unit VIe–1.

Half Moon-Haskill complex

The soils of this complex occupy transitional areas between the medium-textured Half Moon soils and the very sandy Haskill soils. They occur where sand from alluvial fans has been blown over nearly level, silty alluvial terrace deposits and drifted into low mounds and elongated ridges before the material was stabilized by vegetation. In the troughs and pockets between ridges and mounds, windblown sand is a few inches to about 1 foot thick over the silty material. On the ridges, the layer of sand is about as thick as the height of the ridges above the trough.

Half Moon soils with fine sand, loamy fine sand, and fine sandy loam surface soils have developed in the low places between the ridges. Below the sandy surface soils, these soils are similar to Half Moon very fine sandy loam, 0 to 3 percent slopes, but in places the middle and lower subsoil horizons contain a little more sand, and the stratification of silt and sand is more prominent in the deeper substrata.

Haskill fine sand and loamy fine sand have developed on the sandy ridges and mounds. These soils are similar to Haskill fine sand, 0 to 7 percent slopes. On the side slopes of the ridges and mounds, however, the Haskill soils rest abruptly on the silty material of the Half Moon soils at depths of 24 to 40 inches.

Half Moon-Haskill complex, 0 to 3 percent slopes (Hg).—In this mapping unit, the mounds and ridges of Haskill soils are about 4 to 6 feet above the intervening troughs. About 20 percent of the acreage is cultivated. Cultivated areas are usually small fields and patches on small farms owned by families who depend on work off the farm for their income. The acreage not cultivated is used mainly as brushy pasture, but some of it is in dense stands of second-growth ponderosa pine and lodgepole pine.

The sandy surface soils absorb all the rainfall. The moisture moves rapidly to the silty subsoil or substrata where, except in the deepest sands, it is held available for plants. The soils of this complex are easily worked, but they are subject to wind erosion unless protected by surrounding forest. They are used mainly for home gardens, oats, rye, alfalfa, and tame-grass hay. When established, alfalfa grows well on the deep sands because its deep root system can reach the moisture in the underlying silt.

The best uses of this complex of soils are for alfalfa and tame-grass hay and pasture. Tillage should be done only to renew the crops grown for hay. This mapping unit is in capability unit IIIs–2.

Half Moon-Haskill complex, 3 to 7 percent slopes (Hh).—This mapping unit differs from the Half Moon-Haskill complex, 0 to 3 percent slopes, mainly in having slightly higher sand ridges or steeper side slopes of the ridges. In some areas the underlying silt was cut by drainageways, and the windblown sand was deposited over this irregular surface. Where this has occurred, the sands are deep on the side of the ridge occupied by the Haskill soils and shallow on the side occupied by the Half Moon soils.

Little of this mapping unit is in cultivation. If cleared, it could be used as suggested for Half Moon-Haskill complex, 0 to 3 percent slopes, but it is less stable under cultivation because of the higher and steeper ridges that are exposed to wind erosion. This mapping unit is in capability unit IIIs–2.

Haskill series

The Haskill series consists of deep, light-colored, very sandy soils developed in wind-modified sandy deposits on terraces and outwash fans. These soils are on the sandier parts of the terraces in association with the Half Moon soils. Haskill soils have developed from sands that contained a high proportion of fine fragments of green, reddish, and brown argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The sands in places have been reworked by the wind and have formed low dunes. The soils have developed under a forest cover of pine, fir, and spruce.

The Haskill soils are brown sandy soils with extremely thick surface soils and thin subsoils. These soils are slightly acid in the upper part but grade through a neutral subsoil to a highly calcareous parent material.

The Haskill soils have much lighter colored upper horizons than the Blanchard soils.

Typical profile (Haskill loamy fine sand, on north side of highway, 765 feet west of southeast corner of sec. 9, T. 30 N., R. 21 W.):

A_0 1½ to 0 inches, grayish-brown to very dark grayish-brown (10YR 5/2, dry; 3/2, moist) mixture of humus and very fine sand in about equal percentages; matted and slightly firm in place but loose, soft, and fluffy when disturbed.

A_2 0 to 10 inches, very pale brown to pale-brown (10YR 7/3, dry; 6/3, moist) loamy fine sand; soft and loose; slightly acid; boundary gradual.

A_2B 10 to 27 inches, pinkish-gray to brown (7.5YR 6/2, dry; 5/3, moist) loamy fine sand A_2 matrix surrounding brown to dark-brown (7.5YR 4/3, dry; 3/3, moist) loam spots and fine subangular blocks of B_2 material; matrix soft and loose; spots firm when moist, hard when dry, blocks slightly hard when dry; slightly acid; boundary abrupt.

B_2 27 to 32 inches, marbled light-brown and brown to brown and dark-brown (7.5YR 6/4 and 5/3, dry; 4.5/3 and 3.5/3, moist) loam; hard when dry, firm when moist; when a large piece of dry soil is pressed, the darker colored material tends to separate as hard, subangular blocks and the surrounding material as single grains; neutral; boundary abrupt.

C 32 to 72 inches +, pinkish-gray to pale-brown (7.5YR 7/2, dry; 10YR 6/3, moist) fine sand; loose, single grained; calcareous.

The thickness of surface soil varies considerably in Haskill soils; A_1 horizons, 2 to 4 inches thick, are common in some areas.

Haskill fine sand, 0 to 7 percent slopes (Hk).—This soil has the undulating and low hummocky relief typical of areas of blown sand. More than half the acreage is in second-growth forest, some of which is pastured. The cultivated acreage is used for alfalfa, small grain, and tame-grass hay. Unprotected areas are subject to moderate wind erosion. The soil is not well suited to farming. It is in capability unit IVs–3.

Haskill fine sand, 7 to 12 percent slopes (Hm).—This soil differs from the Haskill fine sand, 0 to 7 percent slopes, only in relief. It is in the same general area and in close association with the other phases of Haskill fine sand. However, the surface is more irregular, slopes are steeper, and ridges and hummocks are higher. This soil has a low-dune topography.

This soil is too sandy and its surface is too irregular for general farming. Some areas are cultivated along with more desirable soils. Some small farms, which produce only for home use, are entirely on this soil. Crops grow fairly well in sags between the ridges and knolls. In exposed high places, however, where the soil is subject to wind erosion or is naturally thin, crops are poor and yields are very low. This soil is in capability unit VIes–1.

Haskill fine sand, 12 to 45 percent slopes (Hn).—This soil is similar to Haskill fine sand, 0 to 7 percent slopes, but the horizons are not quite so thick. It consists of little more than sand dunes that have been stabilized by

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forest vegetation long enough for a weakly expressed soil profile to have formed.

A small part of this soil is cultivated. The rest is in forest. Cultivated areas are on slopes of less than 20 percent. Crop yields are low, the wind erosion hazard is high, and the steep slopes are difficult to farm. This soil is in capability unit VIes–1.

Haskill loamy fine sand, 0 to 7 percent slopes (Ho).—The largest areas of this soil are a few miles southeast of Whitefish.

About half the acreage is in cutover and second-growth forest, one-third has been cleared, and the rest is in brushy pasture. Much of the cultivated acreage is farmed with the less sandy and more productive Half Moon and other associated soils. A few small farms that produce mainly for home use are entirely on this soil. Grasses and small grains are the principal crops.

If this soil is bare for long periods, it is subject to moderate wind erosion. It is in capability unit IVs–3.

Haskill loamy fine sand, 7 to 20 percent slopes (Hp).—This soil differs from the Haskill loamy fine sand, 0 to 7 percent slopes, only in degree of slope. It occurs as small, widely scattered areas in association with other Haskill soils.

No area of this soil has enough acreage to constitute an entire farm. Much of the soil occurs in areas that have not been developed extensively for agriculture, and little of it is farmed. Alfalfa is the principal crop where the soil is cultivated. This soil is in capability unit VIes–1.

Kalispell series

The Kalispell series consists of deep, medium-textured, well-drained soils that have developed on outwash fans and glacial lake and stream terraces. The parent alluvium was derived largely from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The soils developed under a moderate cover of grass.

Kalispell soils have dark grayish-brown surface soils and pale-brown subsoils with a coarse, blocky structure. Pronounced zones of lime carbonate accumulations are just below the subsoil.

The Kalispell soils are only slightly lighter colored than Creston soils but have thinner A and B horizons. They are browner, less gray, a little less clayey, and better drained than the Somers soils.

Typical profile (Kalispell loam, in NW¼NW¼ sec. 2, T. 28 N., R. 22 W.):

A_{1p} 0 to 8 inches, dark grayish-brown to very dark brown (10YR 4/2, dry; 2/2, moist) loam; weak, fine and very fine, granular structure; soft when dry, very friable when moist; about neutral in reaction; boundary clear.

B_2 8 to 13 inches, pale-brown to dark-brown (10YR 5.5/3, dry; 3/3, moist) silt loam; weak, very coarse, prismatic and coarse, blocky structure; little or no clay coating on peds; soft to slightly hard when dry, friable when moist; neutral to slightly calcareous in lower 1 inch; boundary clear.

C_{ca} 13 to 30 inches, pale-yellow to light olive-brown (2.5Y 7/3, dry; 5/4, moist) silt loam; massive in place but breaks into weak, medium and fine, subangular blocks or lumps; when dry slightly hard, when moist slightly firm in place but very friable when disturbed; abundant accumulation of floury lime carbonate; boundary gradual.

C 30 to 45 inches +, pale-yellow to light olive-brown (2.5Y 7/3, dry; 5/3, moist) very fine sandy loam; massive; soft when dry, friable when moist; calcareous.

Kalispell soils in the Area vary in texture of the surface soil, thickness of horizons, and depth to free lime carbonate. Substrata of loose sand or of sand and gravel underlie most of these soils at considerable depth but locally are within 2 or 3 feet of the surface. In areas where the Kalispell soils grade into the Tuffit and Demers soils, free salts occur in the lower part of the subsoil.

Kalispell fine sandy loam, moderately deep over sand, 0 to 7 percent slopes (Ka).—This soil is on the highest and generally smooth stream terraces in the area between Kalispell and Somers. Its profile differs slightly from the one described. The surface soil is fine sandy loam, and the lower subsoil and substratum are stratified loamy, sandy, and silty material.

The soil is subject to slight wind erosion if left bare for long periods. Some fields have a few light-colored spots where part of the surface soil has been blown away and spread over the rest of the field. Soil drifting, however, is not evident.

Nearly all of this soil is in cultivation. Wheat is the principal crop and is usually grown in alternate years following summer fallow. The soil contains a moderate supply of organic matter and available plant nutrients. It is in capability unit IIIs–1.

Kalispell gravelly loam, moderately deep over gravel, 3 to 7 percent slopes (Kb).—This soil has a profile similar to the one described, but all horizons are sandier. From 10 to 25 percent of the upper part of the soil is rounded gravel of medium size. The parent material is loose, gravelly, sandy loam containing a fairly high percentage of very fine sand. This soil is on the fairly smooth terrace remnants in the central part of the Upper Flathead Valley Area. The largest acreage is north of Kalispell along the west side of the Stillwater River.

Most of this soil is in cultivation, mainly in winter wheat. The soil is in capability unit IVs–1.

Kalispell gravelly loam, moderately deep over gravel, 7 to 12 percent slopes (Kc).—Except for its steeper slopes, this soil is similar to Kalispell gravelly loam, moderately deep over gravel, 3 to 7 percent slopes. It occupies the rolling and sloping edges of terraces. It is subject to moderate wind and water erosion. The steep slopes are difficult to farm. The soil is in capability unit IVs–1.

Kalispell gravelly loam, moderately deep over gravel, 12 to 40 percent slopes (Kd).—This soil is similar to Kalispell gravelly loam, moderately deep over gravel, 3 to 7 percent slopes, but gravel is more abundant on the surface, the dark surface soil is thinner, and the underlying loose gravel is at less depth. This soil occupies gravelly terrace edges and isolated, steeply sloping terrace remnants.

The stand of native grass is thinner, and it grows less vigorously than on the slightly deeper and less gravelly soils. Also, the steep north- and east-facing slopes have more pine trees than the other Kalispell soils. A few small included areas are mainly in forest.

Most of this soil is used for pasture. A few areas are

cultivated, but yields are low. This soil should be kept in permanent grass and used as pasture to prevent erosion and loss of productivity. This soil is in capability unit VIe–1.

Kalispell loam, 0 to 3 percent slopes (Ke).—This soil has a profile similar to the one described. It occupies a fairly large acreage in the central part of the Upper Flathead Valley Area, north and northwest of Kalispell.

Slight wind erosion is evident on nearly all of this soil. In a few small areas, nearly all the dark surface soil has been drifted into hummocks. Some sand has been blown onto this soil from adjoining very sandy soils. Small spots of sandy soils were mapped with this soil.

This is one of the more extensive soils in the Upper Flathead Valley Area that is good for dryland farming, and most of it is cultivated. The main crops are winter wheat and barley. The soil is easily tilled and is readily permeable to roots, air, and water. It is moderately well supplied with organic matter and plant nutrients when first cultivated. This soil is in capability unit IIe–2.

Kalispell loam, 0 to 3 percent slopes, wind eroded (Kf).—Most of the dark surface soil has been removed from about half or more of the acreage of this soil. Some of it was blown to adjoining areas, some was piled into low drifts surrounding the eroded area, and some was carried long distances. Fields of this soil have a brown-and-white spotted appearance where tillage is now in the brown upper subsoil or in the white, calcareous lower subsoil. Because of erosion and the continuing risk of erosion, this soil is in capability unit IIe–2.

Kalispell loam, 3 to 7 percent slopes (Kg).—This soil has a profile similar to the one described. It consists mainly of many small areas scattered throughout the general area of Kalispell soils. Nearly all of this soil has had slight wind erosion. In places a small amount of soil has been lost through erosion caused by melting snow and heavy rains.

This soil is farmed with larger areas of nearly level Kalispell soils. It is in capability unit IIe–2.

Kalispell loam, 3 to 7 percent slopes, wind eroded (Kh).—This soil is similar to Kalispell loam, 3 to 7 percent slopes, but the dark surface soil has been appreciably thinned by wind erosion. However, in some places the surface soil has been thickened considerably by deposits of soil material blown from other places on the same field or from other fields. Fields of this soil have numerous light-colored spots where tillage is now in the pale-brown, grayish-brown, and white subsoil.

All of this soil has been in cultivation, and most of it is still used for crops. A small acreage has been reseeded to grass, or abandoned and allowed to revert to annual weeds and grasses. This soil is in capability unit IIe–2.

Kalispell loam, 7 to 12 percent slopes (Kk).—The profile of this soil is similar to the one described. The surface soil, however, varies in thickness. In places the lower part of the subsoil and substrata contain more sand, and a few pieces of gravel occur below depths of 2 to 3 feet.

Nearly all of this soil is cultivated along with soils on less steep slopes. Control of runoff and the prevention of wind and water erosion are needed to maintain production. This soil is in capability unit IIIe–1.

Kalispell loam, 12 to 25 percent slopes (Km).—The dark surface soil and the underlying layers are thinner in this soil than in the described profile, and the lower part of the subsoil and the substrata are more variable. In places this soil is definitely sandy below a depth of 3 feet and grades to loose sand and gravel at a depth of 4 feet. This soil is in small areas on strong slopes of drainageways and terrace edges.

Most of this soil on slopes of less than 15 percent is cultivated. The stronger slopes are mainly in native grasses. Wind and water erosion remove the dark surface soil from cultivated fields. There is considerable runoff from heavy rain and melting snow. This soil is in capability unit IVe–1.

Kalispell loam, moderately deep over gravel, 0 to 7 percent slopes (Kn).—The profile of this soil differs slightly from the one described. The surface and subsoil are sandier, and the parent material is fairly gravelly. This soil is in the northern part of the valley on high undulating benches, mainly on the west side of the Stillwater River.

Nearly all of this soil is cultivated. It is friable and permeable and generally has smooth relief. The moisture-holding capacity is good, particularly in the layers above the loose, sand-and-gravel substratum. The depth to the gravel, however, limits the amount of water the soil can hold for growing plants. Crops are damaged in long, dry periods. Winter wheat is the principal crop. This soil is in capability unit IIIs–1.

Kalispell loam, moderately deep over gravel, 7 to 12 percent slopes (Ko).—Except for slope, this soil is similar to Kalispell loam, moderately deep over gravel, 0 to 7 percent slopes. It occupies the rolling and sloping edges of terraces.

This soil is moderately subject to wind and water erosion. It is difficult to farm because of strong slopes. It is in capability unit VIe–1.

Kalispell loam, moderately deep over sand, 0 to 3 percent slopes (Kp).—This soil has a profile similar to the one described, but the lower subsoil and substratum consist of stratified loamy, sandy, and silty materials. The soil occupies nearly level stream terraces. It is easily farmed, and most of it is in cultivation. It is in capability unit IIe–2.

Kalispell loam, moderately deep over sand, 3 to 7 percent slopes (Kr).—The lower subsoil and substratum are sandier in this soil than in the typical profile described. The soil has wavy, irregular relief caused by the uneven deposition of old alluvium. This unevenness is characterized by numerous sags and low ridges that extend in the direction of stream flow. The surface soil is slightly thicker in the sags than on the ridges. Most of the soil is cultivated. It is in capability unit IIe–2.

Kalispell loam, moderately deep over sand, 7 to 12 percent slopes (Ks).—This soil has a profile similar to the one described. It has a slightly thinner surface soil, however, and a sandier lower subsoil and substratum. It occurs on the edges of terraces and in small areas where streams cross or border the terraces. Some scattered, light-gray or nearly white spots occur in fields where the surface soil has been removed by erosion and the subsoil is tilled. Most of this soil is cultivated. It is in capability unit IIIe–1.

Kalispell loam, moderately deep over sand, 12 to 40 percent slopes (Kt).—This soil has a sandier lower subsoil and substratum than described in the typical profile. Its surface soil is 4 to 6 inches thick. Areas of this soil are on the moderately steep to steep terrace edges and breaks and along short, V-shaped drains that border the terraces. All of the soil is idle except the acreage included in pastures. Much of the rainfall runs off, and forage production is fairly low. This soil is in capability unit VIe–1.

Kalispell silt loam, heavy subsoil, 0 to 3 percent slopes (Ku).—The profile of this soil differs from the one described in surface texture and in having a little more clay in the subsoil. It is on nearly level terraces, in slightly lower positions than other Kalispell soils. The parent material is unweathered, stratified, calcareous silt that was deposited on old terraces to a thickness of 3 to 4 feet.

This soil is well suited to small grain under dry farming. Nearly all of it is cultivated, mainly for winter wheat. A small acreage is irrigated from Ashley Creek and used mainly for alfalfa. This soil is in capability unit IIe–2.

Kalispell silt loam, moderately deep over sand, 0 to 7 percent slopes (Kv).—Except for texture of the surface soil, this soil has a profile similar to the one described. It is on broad, nearly level stream terraces in the southern part of the valley. The parent material consists of stratified loamy fine sand, fine sand, and sand and contains thin lenses of silt in most places.

This soil is easy to farm because it is silty and nearly level. Yields are fairly good, and nearly all the acreage is cultivated. Wheat is the main crop. Because of limited and uncertain rainfall, the soil is summer fallowed every 2 or 3 years to acquire moisture for the following crop. Alfalfa does not yield well; the normal supply of moisture is not enough for vigorous growth beyond midsummer. This soil is in capability unit IIe–2.

Kalispell-Demers complex

Areas of this complex are about 70 to 80 percent Kalispell silt loam, moderately deep over sand, and 20 to 30 percent Demers silt loam. These two soils are in such an intricate pattern that it was not feasible to map them separately. The Demers soil occurs as small slick spots within the Kalispell soil.

This complex is mainly on well-drained terraces south of Kalispell. It comprises the best agricultural soils that are transitional between the typical, fairly productive Kalispell soils and Saline-alkali land. The latter includes areas of Demers soils and is poorly suited to cultivated crops.

The main soil in this complex—Kalispell silt loam, moderately deep over sand, has been described. The Demers silt loam is described under the heading Demers-Kalispell complex.

Kalispell-Demers silt loams, 0 to 3 percent slopes (Kw).—This mapping unit is generally free of injurious salts to depths of 2 or more feet, but there is always a likelihood that free salts injurious to plants are in the lower part of the subsoil and substratum of Demers and closely associated soils. The Demers soil has characteristics of a claypan soil because in the early stages of its development free sodium salts were present. Most of the typical Demers silt loam contains small alkali spots, but few, if any, of these spots are in this mapping unit.

Nearly all this complex is farmed. Yields of grain, however, are low because of unproductive slick spots and the droughty claypan in the Demers silt loam. The complex is in capability unit IIIs–4.

Kalispell-Demers silt loams, 3 to 12 percent slopes (Kx).—Areas of this mapping unit are mainly undulating and gently sloping. A few small areas, however, on narrow terrace breaks have moderate to strong slopes. Part of the complex has a topography characterized by low ridges and shallow swales. In the swales along the foot of the ridges and on the terrace edges, where seepage has occurred, there are narrow bands and spots of slightly to moderately saline soils.

Only areas of this complex easily included with less sloping, more productive soils are cultivated. Most of the acreage, including saline spots, is used as pasture. The mapping unit is in capability unit IIIs–4.

Kalispell-Tuffit complex

This complex occurs throughout the general area of the Kalispell soils. It consists of 60 to 80 percent Kalispell silt loam, moderately deep over sand, and 20 to 40 percent Tuffit silt loam and silty clay loam. The Tuffit soils occur as small slick spots within the Kalispell soils.

The main soil in this complex, Kalispell silt loam, moderately deep over sand, has been described. The Tuffit component has a gray, friable surface soil that rests abruptly on gray, silty clay subsoil. The subsoil is hard and compact; it breaks into coarse, blocky aggregates when dry, but it is sticky, plastic, and massive when wet.

The Tuffit soils have developed under grass in material derived from gray, green, and reddish argillite of the Belt geologic formation.

Within areas of this complex are soils in all stages of salinization and Solonetz development.

Typical profile (Tuffit silty clay loam, in the NE¼NE¼NW¼ sec. 20, T. 27 N., R. 20 W.):

A_1 0 to 4 inches, dark-gray to very dark brown (10YR 4.4/1, dry; 2/2, moist) silty clay loam; granular structure; slightly alkaline, pH about 7.5; boundary abrupt.

B_2 4 to 12 inches, gray to very dark grayish-brown (10YR 5/1, dry; 3/2, moist) silty clay; columnar to blocky structure; hard when dry, plastic when moist; very strongly alkaline, pH about 9.0; boundary clear.

B_{3ca} 12 to 29 inches, very pale brown to pale-brown (10YR 7/3, dry; 6/3, moist) silt loam; irregular, weak, blocky structure; moderately compact and hard when dry, friable when moist; calcareous, pH 9.0; boundary gradual.

C_{ca} 29 to 48 inches, very pale brown to pale-brown (10YR 8/4, dry; 6/3, moist), silty very fine sandy loam; no definite structure; friable; calcareous; boundary gradual.

CD 48 inches +, pale-yellow, gray, or very pale brown, stratified silty to sandy parent alluvium.

Horizons of the Tuffit soils vary in thickness from place to place.

Kalispell-Tuffit silt loams, 0 to 3 percent slopes (Kza).—This mapping unit occurs in areas of 20 to 100 acres or more. About 80 percent of it is cultivated, and the rest is in pasture. This mapping unit is in capability unit IIIs–4.

Kalispell-Tuffit silt loams, 3 to 7 percent slopes (Kzb).—This mapping unit is on moderate, irregular slopes. Individual areas are 30 acres or less in size. Nearly all of this complex is cultivated—mainly for wheat. It is in capability unit IIIs-4.

Kalispell-Tuffit silt loams, 7 to 20 percent slopes (Kzc).—This mapping unit is on the steeper slopes of drainageways and on the rolling, dissected edges of terraces. The individual areas contain from 5 to 30 acres.

Runoff is fairly rapid on the stronger slopes. This complex is subject to moderate water and wind erosion. Except for the parts consisting of friable, permeable Kalispell soils, it is relatively unproductive. However, most of the complex is farmed with better soils. This mapping unit is in capability unit VIe-1.

Kiwanis series

The Kiwanis series consists of shallow, loamy soils developed in stratified, medium and moderately coarse, calcareous alluvium on high bottom lands or low terraces. The parent alluvium, largely reworked glacial drift, was derived from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The vegetation under which the soils developed was dominantly grass but consisted also of moderate stands of conifers and of mixed stands of coniferous and deciduous trees and shrubs.

The surface soil of the Kiwanis soils is dark loam with weak structure. It rests on the parent material, which is also loamy.

The Kiwanis soils have a much thicker dark surface soil and a coarser, a more sandy subsoil and much coarser substrata below a depth of 3 or 4 feet than the Swims soils. They have a thinner surface soil, a more stratified and more sandy subsoil, and much coarser substrata below 3 or 4 feet than the Creston soils.

Typical profile (Kiwanis loam, on the west side of road, 560 feet south of the north quarter-section corner in NE¼NW¼ sec. 28, T. 29 N., R. 21 W.):

A_{11} 0 to 2 inches, dark grayish-brown to very dark brown (10YR 4/2, dry; 2/2, moist) loam; weak, fine, granular structure; soft when dry, very friable when moist; neutral reaction; boundary clear.

A_{12} 2 to 9 inches, grayish-brown to very dark grayish-brown (10YR 5/2, dry; 3/2, moist) loam; weak, soft, crumb structure; soft when dry, very friable when moist; neutral reaction; boundary clear.

C 9 to 39 inches, very pale brown to pale-brown (10YR 8/3, dry; 6/3, moist) fine sandy loam; massive but breaks into soft, irregular lumps; calcareous; boundary abrupt.

D_1 39 to 58 inches, light-gray to light brownish-gray (10YR 7/2, dry; 6/2, moist), loose, coarse sand; calcareous; boundary gradual.

D_2 58 to 70 inches +, same as layer above except that gravel is abundant.

In the Kiwanis soils, there is a wide range in the thickness and darkness of the surface layer and in the depth to the loose substrata. In most areas the soils are calcareous within or near plow depth.

Kiwanis fine sandy loam, 0 to 4 percent slopes (Kzd).—The profile of this soil differs from the one described in having a sandier and slightly lighter colored surface soil and subsoil. In addition, the loose, coarse substratum is as near as 24 inches to the surface in places. This soil occupies fairly large areas east and northeast of Kalispell and broad, low terraces between the Flathead and Whitefish Rivers.

A large percentage of this soil has been cleared and cultivated. Wheat is the principal crop on the larger farms. The rest has been cut over and is used as brushy pasture. A number of suburban residences and small farms are located on this soil. The owners of the small farms market a small amount of produce, but they depend on outside work for a large part of their income. This soil is in capability unit IIIs-1.

Kiwanis loam, 0 to 3 percent slopes (Kze).—This soil occupies nearly level, low stream terraces or high bottom lands that are above floods. A few small areas are imperfectly drained. In these areas the ground water is in contact with the fine earth material above the gravel. It rises through capillary action and benefits most crops, especially hay and pasture. This soil occurs in association with Kiwanis fine sandy loam, 0 to 4 percent slopes, and is used in about the same manner. It is in capability unit IIw-1.

Kiwanis loam, 3 to 9 percent slopes (Kzf).—This soil has a slightly thinner surface soil than the soil described. It occurs mainly as small, widely scattered spots in the general area of Kiwanis soils. It is on short slopes that border shallow drainageways and on edges of low terraces that break to the lower flood plains of the larger streams.

This soil does not comprise a large acreage on many farms. Most of it is left in grass and used for hay or pasture. Little is cultivated. It is in capability unit IIIe-1.

Kiwanis-Birch fine sandy loams, 0 to 5 percent slopes (Kzg).—This complex includes about equal parts of Kiwanis fine sandy loam, 0 to 4 percent slopes, Birch fine sandy loam, 0 to 5 percent slopes, and soils that are transitional between these in depth to the loose gravel or sand and gravel substrata. These soils occur in such an intricate pattern that it was not feasible to map them separately.

This complex of soils comprise a fairly large total area east and northeast of Kalispell. It is associated with the larger areas of Kiwanis and Birch soils. Most of it is under cultivation. Because of the lower water-holding capacity and shallow rooting zone in the shallow Birch soil, crops show uneven growth in fields of this complex. This complex is in capability unit IVs-1.

Kiwanis-Birch loams, 0 to 4 percent slopes (Kzh).—This complex consists of an intricate association of Kiwanis loam, 0 to 3 percent slopes, and Birch fine sandy loam, 0 to 5 percent slopes. It is in the general area of Kiwanis and Birch soils east and northeast of Kalispell. A large part of this complex is cultivated. Some is used for brushy pasture. Because of the shallow, droughty Birch soil, crop growth is uneven and yields are lowered. This complex is in capability unit IVs-1.

Krause series

The Krause series consists of shallow, loamy soils over loose, coarse materials. These soils have developed in the alluvial and outwash fans along the east side of the valley. The parent material was derived mainly from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. It contains gravel, cobbles, and large stones. The Krause

soils developed under a cover of fir, lodgepole pine, and spruce and some deciduous shrubs and coarse grasses.

These soils have a very thin, grayish-brown, gravelly loam surface soil and a yellowish-brown gravelly loam subsoil about 1 foot thick. Below are gravelly sands.

Krause soils are excessively drained. The permeability is very rapid below the upper 1 foot.

Krause soils do not have the thick, very dark surface soil characteristic of the Mires soils. They differ from the Waits soil in having a thinner subsoil, coarser parent material, and shallower profile.

Typical profile (Krause gravelly loam, along highway in NW¼NW¼ sec. 26, T. 28 N., R. 20 W.):

A_1 0 to 1 inch, grayish-brown to very dark brown (10YR 4.5/2, dry; 2/2, moist) gravelly loam; weak, fine, crumb structure; soft when dry, friable when moist; medium acid; boundary abrupt.

B_2 1 to 12 inches, light yellowish-brown to dark yellowish-brown (10YR 6/5, dry; 4/4, moist) gravelly loam; massive; slightly firm in place but loose, fluffy, and very friable when disturbed; medium acid; boundary gradual.

BC 12 to 20 inches, pale-brown to brown (10YR 6/3, dry; 4/3, moist) very gravelly sandy loam; massive to loose, single-grained; slightly acid to medium acid; boundary clear.

D 20 to 60 inches +, loose, very gravelly, and cobbly coarse sand; calcium carbonate crusts on lower sides of gravel below a depth of 5 or 6 feet.

Coarse fragments vary in amount and size in and on Krause soils. The depth to the loose, coarse, gravelly sand ranges from 12 to 20 inches.

Krause gravelly loam, 0 to 3 percent slopes (Kzk).—This soil has fewer large stones on the surface and in the soil than the other Krause soils. It occupies fairly smooth slopes, and most of it is forested. Small areas have been cleared for home gardens, berries, and winter forage for livestock, chiefly dairy cows, which are grazed on adjoining cutover land. Yields of all crops are low. Where the cultivated areas are near streams, the crops are irrigated and yields are increased. This soil is in capability unit IVs–4.

Krause gravelly loam, 3 to 7 percent slopes (Kzm).—This soil is on fairly large areas in the vicinity of Lake Blaine. It is generally shallow over loose gravel, low in water-holding capacity, and low in productivity. Consequently, most areas are unsuitable for extensive farming. This soil is used in about the same way as Krause gravelly loam, 0 to 3 percent slopes. It is in capability unit IVs–4.

Krause gravelly loam, 7 to 12 percent slopes (Kzn).—This soil occupies irregular, hummocky, and moderately sloping areas along some of the drainageways, where it is associated with the more gently sloping, gravelly or stony soils. All of this soil is forested, but most of the large trees have been cut. Young trees are growing in the open places. This soil is in capability unit VIe–1.

Krause gravelly loam, 12 to 35 percent slopes (Kzo).—This soil is on edges of outwash fans, steep slopes along drainageways, and steep hills where gravelly Krause soils join the stony Waits soils. The soil profile on the strongest slopes is slightly thinner than the typical profile described.

This soil is too steep and rough for cultivation, and most of it is too steep for grazing. Its best use is for forestry and wildlife. It is in capability unit VIe–1.

Made land

This miscellaneous land type consists of artificially filled areas.

Made land (Ma).—This mapping unit consists of city dumps and landfills and sawmill refuse that has been smoothed and used as lumber stackyards. Only two or three areas of this land type were mapped. This land type was not placed in a capability unit.

McCaffery series

The McCaffery series consists of moderately deep, brownish, sandy soils on outwash fans and terraces. These soils were derived from weathered gray, green, brown, and reddish argillite and quartzite of the Belt geological formation, with enough dolomitic limestone to make the deep strata calcareous. The native vegetation is a mixed coniferous forest in which there are scattered deciduous trees, shrubs, and low-growing plants. Coarse grasses grow in the cutover areas.

These soils have a surface soil that consists of very thin, grayish-brown sandy materials with no structure. The subsoil is pale-brown loamy fine sand with little structure. It overlies light-gray loose sand. The soils in this series are excessively drained. Nearly all rain is easily absorbed and percolates rapidly through subsoils and substrata.

McCaffery soils are coarser textured than Selle soils, but they do not have the high content of gravel that is in the Krause soils. The surface soil is not so thick nor so dark as in the Blanchard soils, and carbonates have been leached more deeply.

Typical profile (McCaffery loamy fine sand):

A_1 0 to 1 inch, grayish-brown to dark grayish-brown (10YR 5/2, dry; 3.5/2, moist) loamy fine sand; single-grained; fairly high in organic matter; slightly acid; boundary clear.

B_{21} 1 to 11 inches, pale-brown to brown (10YR 6.5/3, dry; 5/3, moist) loamy fine sand; loose and single grained when dry, fairly coherent when moist; medium acid; boundary gradual.

B_{22} 11 to 21 inches, very pale brown to grayish-brown (10YR 7/3, dry; 5/2, moist) loamy fine sand; little coherence except for a sprinkling of darker brown, firm spots or lumps; slightly acid; boundary gradual.

BC 21 to 30 inches, light-gray (10YR 7/2) loamy sand; loose; slightly acid; boundary clear.

C 30 to 40 inches, light-gray (10YR 7.5/2) sand; loose, slightly acid, becoming neutral in lower part.

The thickness of profile, depth to loose sand, and the content of coarse sand are variable in the McCaffery soils.

McCaffery coarse sand, 0 to 5 percent slopes (Mb).—Besides differing in texture of the surface soil, the profile of this soil is not so brown and has more fine gravel throughout than the typical profile. It occurs mainly in several large areas on undulating and gently sloping outwash fans that are slightly higher above streams than most of the McCaffery loamy fine sands. Nearly all of this soil is in the vicinity of Ferndale in Flathead and Lake Counties.

This soil is in forest. Its coarse sandy texture, low water-holding capacity, and low potential productivity make it unsuited to farming. It is in capability unit IVs–3.

McCaffery loamy fine sand, 0 to 3 percent slopes (Mc).—This soil occurs mainly east and southeast of Echo Lake and in the Swan River vicinity.

This soil is mostly in cutover forest. There are a few small homesteads or rural residences on it. Small clearings are used for home gardens and berries and for hay and grain for the family cow or for a few beef cattle. The main income for operators of these farms is obtained from work off the farm. The soil is too droughty and crop yields are too low for successful large-scale farming. It is in capability unit IVs–3.

McCaffery loamy fine sand, 3 to 7 percent slopes (Md).—This soil has a profile similar to the one described. It is in widely scattered areas where sand was drifted into low ridges before it was stabilized, or where it was unevenly deposited by streams and water from glaciers.

Most of this soil is in cutover forest. A few small areas along the Swan River have been cleared. Most of the cleared acreage is used for strawberries, raspberries, small grain, and alfalfa and tame-grass hay and pasture for family cows and a few beef cattle. This soil is in capability unit IVs–3.

McCaffery loamy fine sand, 7 to 12 percent slopes (Me).—This soil occurs mainly in small areas and narrow bands on the sloping edges of terraces and on the breaks to streams. Only a few small patches that are farmed with other less sloping and more easily managed soils have been cultivated. The rest is in cutover or second-growth forest, of which some is used for pasture. This soil is in capability unit IVs–3.

McCaffery loamy fine sand, 12 to 30 percent slopes (Mf).—The profile of this soil is similar to the one described, but the lower layers contain more coarse sand, and some spots contain thin strata and lenses of gravel. The soil occurs in widely scattered areas on the sloping edges of fans and terraces and in deeply channeled areas where streams and glacial runoff deposited the parent material.

This soil is too steep and irregular for cultivation, and most of it is in cutover and second-growth forest. A few small areas near farmsteads are used as brushy pasture. Cattle obtain only a small amount of forage from the annual weeds, shrubs, and grass on these pastures. This soil is in capability unit VIes–1.

Mires series

The Mires series consists of moderately deep, medium-textured soils with a gravelly, coarse-textured lower subsoil and substratum. The soils have developed in calcareous outwash and terrace alluvium. The parent materials were deposited by swift waters during the retreat of the glaciers from the valley and adjacent mountain slopes. The native vegetation was a moderate to dense cover of grasses, tall to medium in height, some trees, and small groves of ponderosa pine.

The Mires soils have a dark loam or gravelly loam surface soil about 8 inches thick. The moderately dark subsoil is gravelly loam. It is underlain by loose, very gravelly sand at depths of 14 to 20 inches.

These soils are well drained to somewhat excessively drained. Runoff is slow, as most of the water enters the soil. The water moves rapidly downward after it enters the gravel layer.

The Mires soils lack the abundance of large, angular stones and boulders and the heavy concentration of free lime carbonates characteristic of the Yeoman soils. The Mires soils have a finer textured upper subsoil than the Blanchard soils.

Typical profile (Mires gravelly loam, in the SE¼SE¼ sec. 16, T. 30 N., R. 20 W., 260 feet north of road intersection on west side of highway):

A_1 0 to 8 inches, very dark grayish-brown to black (10YR 3/2, dry; 2/1, moist) gravelly loam; weak, very fine, granular structure; very friable when moist but loose, soft, and powdery when dry; many grass roots; neutral or slightly acid; boundary clear.

B_{21} 8 to 14 inches, dark-brown to very dark brown (7.5YR 4/3, dry; 2/3, moist) gravelly loam; irregular, blocky lumps that break to a weak, very fine, granular structure; very friable when moist, soft and loose when dry; many grass roots; about neutral in reaction; boundary gradual.

B_{22} 14 to 18 inches, brown to dark-brown (10YR 4.5/3, dry; 7.5YR 3/3, moist) very gravelly sandy loam; massive; very friable when moist, soft when dry; grass roots common; neutral reaction; boundary clear.

D_{ca} 18 to 36 inches, light brownish-gray to grayish-brown (10YR 6/2, dry; 5/2, moist) very gravelly loamy sand; loose, single-grained; few grass roots; calcareous, most of the free calcium carbonate is in thin crusts on the lower sides of gravel; boundary gradual.

D 36 inches +, loose gravel and coarse sand; gravel is partly or entirely coated with calcium carbonate.

In the Mires soils, the amount and size of gravel vary considerably in the surface soil. Areas that have little or no gravel are deepest over loose gravel. The depth to free lime carbonate varies from 18 to 36 inches. Areas of these soils that developed under a mixture of grass and trees have lighter colored surface soils than those that developed under grass alone.

Mires gravelly loam, 0 to 3 percent slopes (Mg).—This soil is on relatively broad, nearly level, high, old terraces and on alluvial and outwash fans that border the eastern and western sides of the valley, mainly north of Kalispell.

The surface soil contains 10 to 20 percent of gray quartzite gravel and green and reddish gravel (argillite) as much as 3 inches in diameter. Gravel does not seriously interfere with cultivation.

This soil is droughty because it is shallow to loose gravel. In addition, rainfall is generally low during the growing season. Most of this soil has been dry farmed—mainly for wheat. Yields are fair to good when summer rains are above average, but they are low in dry years. Crops often fail. This soil is in capability unit IVs–1.

Mires gravelly loam, 3 to 7 percent slopes (Mh).—This soil differs from Mires gravelly loam, 0 to 3 percent slopes, mainly in relief. In addition, it has a slightly thinner dark surface soil where it occurs on low hummocks and ridges and on slopes next to drains. In many places the two soils occupy adjoining areas—in places parts of the same field. In use and management, this soil is similar to Mires gravelly loam, 0 to 3 percent slopes. This soil is in capability unit IVs–1.

Mires gravelly loam, 7 to 12 percent slopes (Mk).—This soil has a slightly thinner surface soil than that described in the typical profile. The depth to loose gravel averages about 15 inches. This soil is in strongly rolling areas near the edge of terraces and on the

steeper parts of fans where the alluvial deposits were irregular and were cut by streams when deposited. In places it is on stony hummocks surrounded by depressions that have no surface drainage.

Small acreages of this soil on the more gentle slopes have been used for wheat, but most of the cultivated areas have been seeded to grass and are now used as pasture. This soil is in capability unit VIe–1.

Mires gravelly loam, 12 to 30 percent slopes (Mm).—This soil has a profile similar to the one described. The surface soil, however, is seldom more than 6 inches thick, and loose gravel is about 15 inches below the surface. The soil is on breaks between terrace levels and on small areas deeply entrenched by drains.

All of this soil is in native vegetation, mainly grass. There is a scattering of pine and some leafy shrubs along the drainageways. This soil is idle or is used as pasture. It is in capability unit VIe–1.

Mires loam, 0 to 3 percent slopes (Mn).—This soil has a profile similar to the one described as typical, but the surface soil and upper subsoil do not contain gravel. The soil is on nearly level, largely gravel-free high fans and terraces that border the eastern side of the valley.

Although the acreage of this soil is fairly small, it includes most, or all, of the easily tilled soil on some farms. For this reason, and because it is productive in years of above-average rainfall, it is nearly all used for wheat or other small grain and for forage crops. It is in capability unit IIIs–1.

Mires loam, 3 to 7 percent slopes (Mo).—This soil has a little more irregular and slightly stronger slopes than Mires loam, 0 to 3 percent slopes. Cleanly cultivated or closely grazed areas have some runoff on steeper slopes and slight erosion during heavy rains. The soil is in capability unit IVs–1.

Mires loam, 7 to 12 percent slopes (Mp).—This soil is on the sloping and rolling terrace edges where the irregularly deposited parent material occurs as hummocks. The native vegetation of grass was not quite so dense, and its growth not quite so vigorous, as on the more gently sloping Mires loam. As a result, the surface layer has less organic matter and it is not quite so thick nor so dark as in Mires loam, 0 to 3 percent slopes.

Fairly strong slopes and irregular surface make most of this soil unsuited to tillage. Most of it is in pasture. The soil is in capability unit IVs–1.

Mountainous land

This miscellaneous land type consists of Waits stony silt loam, Whitefish cobbly silt loam, and barren rock.

Mountainous land (Mr).—This mapping unit occupies low hills and mountains on the alluvial plain of the valley. The Waits soils occur higher on the mountain slopes than the Whitefish soils. Both of these soils are well forested, mainly with Douglas-fir, balsam fir, and lodgepole pine. Some larch, ponderosa pine, and white pine grow on the lower slopes. The large trees have been cut from the more accessible slopes. Some of the barren rock slopes are sparsely covered with trees.

Most of the acreage is too steep, stony, and remote for agricultural use, and all of it is in forest. A few cattle are grazed on cutover land near farmsteads. This land type is in capability unit VIIs–1.

Muck and Peat

Muck and peat occur in old cutoff channels of the Flathead River, in depressions of the present flood plain, and in low positions on the borders of some lakes.

Muck and Peat (Ms).—This mapping unit consists of the deposits of mosses, rushes, grasses, sedges, cattails, trees, and other woody plants in various stages of decomposition. The depth of these deposits over mineral soil ranges from 1 to more than 4 feet. The material in small areas and parts of the larger areas came mainly from the remains of grasses and grasslike plants, but that in most areas came from the remains of brush and trees. Many small intermittent lakes and kettle holes along the east side of the valley contain shallow or thick deposits of muck and peat, and many small streams meander through it.

All areas are moist or saturated most or all the time, unless they have been drained artificially. Muck forms when the water level drops below the surface part of the time, as the decomposition of plant remains is then rapid. Peat forms when the water level stays above the surface nearly all the time, as then there is little decomposition of plant remains.

Areas of Muck and Peat not flooded consist mainly of organic material. Where periodically flooded, the organic matter is mixed with mineral-soil sediment and all layers are dark brown. In places thin bands of mineral soil occur between layers of muck and peat.

A typical area of peat borders the north edge of Smith Lake where the water level is high most of the summer. Farther north of the lake, an area of muck has formed where the water level drops below the surface during summer irrigation. Part of the muck dries out enough to be farmed, and the rest is used as hay meadows and pasture.

Most of the acreage of Muck and Peat is too low to be drained for farming. The seasonal fluctuation of the water table allows some areas to dry out enough to be grazed part of the year and to be mowed for hay late in summer and in fall. Some areas have been drained enough to allow plowing and the seeding of tame grasses, mainly timothy and redtop and alsike clovers to improve hay. A few small fields have been drained enough to allow the seeding of oats, which is generally harvested for hay rather than for grain. This mapping unit is in capability unit Vw–1.

Prospect series

The Prospect series consists of deep, loamy soils developed from medium-textured, calcareous, glacial till. The parent material was derived mainly from quartzite, argillite, and dolomitic limestone of the Belt geological formation. These soils developed under a moderate to good cover of upland grasses and scattered pine trees and small groups of pines.

Prospect soils have a dark-gray, loamy surface soil. They have a grayish-brown subsoil 8 to 10 inches thick, with a weakly developed blocky structure. The layer just below the subsoil contains a large amount of soft, floury lime.

These soils are well drained, and they are moderately permeable. Runoff from gentle slopes is low to moderate, but it is high from cultivated fields on stronger slopes.

The Prospect soils have a lighter colored A horizon and thinner A and B horizons than the closely related Yeoman soils. In addition, carbonates have not been leached so deeply. Prospect soils differ from Whitefish soils, developed in the same kind of till, in having darker horizons, a less clayey B horizon, and a shallower accumulation of free lime carbonate.

Typical profile (Prospect stony loam, one-quarter mile west and 600 feet north of SE corner of sec. 28, T. 29 N., R. 22 W.):

A_{11} 0 to 2 inches, dark-gray to very dark brown (10YR 4/1, dry; 2/2, moist) stony loam; weak, fine, platy and fine, crumb structure; soft when dry, very friable when moist; about neutral in reaction; boundary clear.

A_{12} 2 to 6 inches, dark-gray to very dark brown (10YR 4/1.5, dry; 2/2, moist) stony loam; weak to moderate, fine, granular structure; soft when dry, very friable when moist; about neutral; boundary clear and irregular.

B_2 6 to 11 inches, grayish-brown to very dark grayish-brown (10YR 5/2, dry; 3/2, moist) stony silt loam; weak, medium and coarse, prismatic structure separating into weak or moderate, medium, blocky structure; soft when dry, friable when moist; neutral in reaction; boundary clear.

B_3 11 to 14 inches, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 4/2, moist) stony silt loam; weak, medium and coarse, prismatic structure separating into moderate, medium, blocky structure; soft when dry, very friable when moist; neutral in reaction; boundary abrupt and irregular.

C_{ca} 14 to 24 inches, white to light brownish-gray (2.5Y 8/2, dry; 6/2, moist) stony and gravelly silt loam; weak, coarse and medium, subangular blocky structure; slightly firm in place but loose and very friable when disturbed; large amount of soft, floury, segregated lime carbonate; boundary clear.

C 24 to 30 inches +, loam till that is light-gray, friable, calcareous, stony, and gravelly.

The horizons of the Prospect soils vary in thickness. The depth to free carbonates ranges from 10 to 18 inches. Various sizes and amounts of angular and subangular rock fragments are in the soil and parent material. Some have had large stones removed to facilitate tillage and harvesting of crops.

Nearly all areas of the Prospect soils include small tracts of somewhat stony soils on low ridges and, in low spots and swales, soils with thicker dark surface layers.

Prospect loam, 0 to 3 percent slopes (Pa).—This soil occupies nearly level upland west of Kalispell. It contains only a sprinkling of rock fragments and gravel. Large stones occur on the surface and in the upper part of the soil in a few places. Rock fragments increase with depth, but they are not so abundant as in the profile described. Nearly all of this soil is cultivated. The prevailing low rainfall seldom moistens the soil below the root zone of most crops. The lack of moisture frequently limits the growth of roots and the yields of crops. Because of the limited moisture and drought hazard in most years, small grains, mainly wheat, are the principal crops.

This soil is well suited to irrigation, but the irregular surface makes the distribution of water difficult under a gravity system. For dry farming, this soil is in capability unit IIe–2.

Prospect loam, 3 to 7 percent slopes (Pb).—This soil is used in the same manner and requires the same treatment as Prospect loam, 0 to 3 percent slopes. It is in capability unit IIe–2.

Prospect loam, 7 to 12 percent slopes (Pc).—This soil differs from Prospect loam, 0 to 3 percent slopes, in gradient and in having a thinner surface soil, especially on the more exposed ridges and steeper slopes. Runoff is moderate and sheet erosion is slight if cultivated fields are left bare for long periods. In a few places the lighter colored, calcareous subsoil has been mixed with the thin surface soil during tillage.

The soil is nearly all cultivated and is used mainly for wheat. It is in capability unit IIIe–1.

Prospect loam, 12 to 20 percent slopes (Pd).—This soil is similar to Prospect loam, 0 to 3 percent slopes. It differs, however, in gradient, and it has a surface soil that is about 8 inches thick. In addition, it has a little more gravel and a few more large stones on the surface and in the soil. Stronger slopes make this soil more difficult to farm than the other phases of Prospect loam. Some areas are cultivated with other less sloping soils. Most of the acreage is used as pasture, and, if not overgrazed, the stand of native grasses is usually good. Runoff from the steeper slopes is moderate to high during heavy rains. This soil is in capability unit IVe–1.

Prospect stony loam, 3 to 7 percent slopes (Pe).—This soil is well situated for farming, and most of it is cultivated. Some of the largest stones have been placed in piles or removed from the fields. On some fields, stones 6 inches or more in diameter interfere with tillage, the harvesting of crops, and the use of heavy machinery. This soil is in capability unit Vs–1.

Prospect stony loam, 7 to 12 percent slopes (Pf).—This soil is similar to Prospect stony loam, 3 to 7 percent slopes. It is, however, steeper and more rolling and has a few more large stones. In addition, the dark surface soil is slightly thinner on the top of narrow ridges and hills and on the steeper slopes.

This soil makes up most of the area of many farms. Most of the acreage is cultivated, mainly for wheat. This soil is in capability unit VIe–1.

Prospect stony loam, 12 to 20 percent slopes (Pg).—This soil is more variable in thickness of the surface layer, has stronger slopes, and has more large stones than Prospect stony loam, 3 to 7 percent slopes. Areas are small and scattered.

This soil is used largely for pasture, but small areas having slopes of 12 to 15 percent are cultivated with soils of less slope. This soil is in capability unit VIe–1.

Prospect stony loam, 20 to 45 percent slopes (Ph).—This soil differs from Prospect stony loam, 3 to 7 percent slopes, in that slopes are stronger, large stones are more numerous, and the surface soil is thinner and lighter colored. However, in some areas, the surface soil is as thick and as dark as that of the profile described. In other areas, the dark surface soil is only 4 to 6 inches thick.

All of this soil is in native grasses. The grass is thinner and less vigorous on steep slopes because of the loss of moisture through runoff. Some slopes are too steep for grazing. This soil is in capability unit VIe–1.

Prospect-Tuffit complex

This complex consists of areas of Prospect silt loam and Tuffit silt loam in such an intricate association that they could not be mapped separately. The Prospect soil

has been described in the Prospect series, and Tuffit soil has been described under the Kalispell-Tuffit complex.

The Tuffit member of the complex has developed in alluvium on the lower parts of gentle slopes and in pockets and narrow swales between the low hummocks and ridges of Prospect soils. At depths of 3 to 4 feet, most Tuffit soils grade into till. The Prospect member of the complex has developed in glacial till.

This complex occurs with large areas of Prospect soils. It occupies transitional positions between the main body of the Prospect soils and the typical Tuffit soils on alluvial terraces. In this position, the soils have received runoff and seepage that contained considerable sodium salts. As a result, the upper part of the subsoil is very strongly alkaline (high sodium saturation), and the lower part contains an accumulation of salt. This saline-alkali condition is detrimental to most crops.

When tilled, part of the Tuffit claypan subsoil is brought to the surface, and it gives fields a spotted, rough, cloddy appearance. During rains, the clods tend to melt, or disperse, and to form slick spots that have a hard crust when dry. Crops do not grow well and may die in dry seasons. Yields are low.

Prospect-Tuffit silt loams, 0 to 3 percent slopes (Pk).—This mapping unit is on the more level parts of the complex. Where the saline-alkali condition is not too serious or does not affect more than 25 percent of the area, this mapping unit is farmed with better soils. Much of the acreage is used for pasture. This complex is in capability unit IIIs–4.

Prospect-Tuffit silt loams, 3 to 7 percent slopes (Pm).—This mapping unit occurs as small areas on gentle slopes of uplands where the Prospect soils merge with the valley terraces and with alluvial soils along small streams that drain the Prospect soils. When cultivated, this mapping unit is used with other soils. It is in capability unit IIIs–4.

Prospect-Tuffit silt loams, 7 to 20 percent slopes (Pn).—This mapping unit is on the steeper and more irregular slopes of the complex. The surface soil of the Tuffit member is a little less clayey, and the substrata consist of till rather than the stratified alluvium typical of Tuffit soils. Most areas are in grass. This mapping unit is in capability unit VIs–2.

Radnor series

The Radnor series consists of moderately deep, poorly drained soils in depressed areas that have poor drainage. These soils occur in old cutoff channels of the Flathead River and in swales, drainage channels, and low areas on alluvial fans, terraces, and bordering upland till.

The parent material is medium and moderately fine textured glacial lake and stream sediments, derived in a large part from argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The soils have developed under coarse marsh grasses, sedges, rushes, and shrubs. Nearly all areas have a few trees, and most have sparse to heavy stands of spruce, fir, and willow.

The soils have a muck or peatlike surface layer, 2 to 8 inches thick, and a gray, clayey surface soil, 4 to 8 inches thick. The subsoil is gray silty clay loam that is mottled and stained with brown and yellow. The material below is nearly white and is variable in texture.

The water table in the Radnor soils is generally within 2 or 3 feet of the surface. Most of these soils are flooded part of the time. Some remain wet to the surface throughout the year.

The Radnor soils are more poorly drained, have more weakly differentiated horizons, and are more mottled than the moderately well drained Half Moon and imperfectly drained Stryker soils.

Typical profile (Radnor silty clay loam, in a cultivated field of 1 percent slope, in the SE¼SE¼ sec. 28, T. 31 N., R. 21 W.):

A_p 0 to 5 inches, gray to dark-gray (10YR 6/1, dry; 4/1, moist) silty clay loam; weak, fine and very friable, granular structure; many fine, platelike chips of the original lighter colored, medium, platy A_2 layer that have been mixed with the A_0 and thin A_1 layers; slightly calcareous from local overwash; boundary abrupt.

A_2 5 to 14 inches, white to dark-gray (10YR 8/1, dry; 2.5Y 4/1, moist) silty clay loam; moderate, thick, platy structure; slightly hard when dry, slightly firm when moist; noncalcareous; boundary clear.

B_2 14 to 30 inches, white to gray (2.5Y 8/1, dry; 5/1, moist) silty clay loam; common, faint to prominent, fine, brown and yellow mottles; weak, medium, blocky structure; hard when dry, firm when moist; noncalcareous; boundary clear.

C 30 to 40 inches +, white to light-gray (5Y 8/1, dry; 6/1, moist), little altered, thinly stratified, silt loam and silty clay loam alluvium; common, prominent, fine and faint, medium-brown and yellowish mottles; hard when dry; firm when moist; alkaline to slightly calcareous.

The characteristics of Radnor soils vary according to the drainage. Where the soils are wet all year and ponded part of the time, a thin layer of peat forms on the surface and the soils are light colored throughout. In the better drained sites, the B_2 horizon tends to be somewhat brown, yellowish-brown, or yellow; the blocky peds are coated with dark-brown organic stains; and the mottles are coarser and more strongly defined. In some places, the soils contain no free lime carbonate, whereas only a short distance away they are limy below the A_2 horizon and have moderate accumulations of carbonate in the C horizon. In some areas stratified sand, silt and sand, and, in spots, gravel occur below a depth of 3 or 4 feet.

Radnor silt loam, 0 to 3 percent slopes (Ra).—This soil differs from the one described in texture of the surface soil. A large part of this soil is not productively used. Much of the acreage is too wet to be satisfactory as pasture. If this soil is used for agriculture, only accessible areas are grazed. Some areas are dry enough later in summer to allow the cutting of wild hay. Where drainage outlets can be established, the drained areas are used as hay meadows and for improved pasture. Some small areas have been drained enough to allow seeding of oats for hay or grain. This soil is in capability unit Vw–1.

Radnor silty clay loam, 0 to 3 percent slopes (Rb).—This soil occurs as fairly large areas bordering Flathead Lake. It is used in about the same manner as Radnor silt loam, 0 to 3 percent slopes, and it is also in capability unit Vw–1.

Riverwash

Riverwash is fresh alluvium not yet developed into a soil.

Riverwash (Rc).—This mapping unit consists of areas of light-colored, alluvial sand mixed with a small amount of gravel that borders the Flathead River. Some of the areas in sharp river bends are mainly gravel and a little coarse sand.

The mapping unit is subject to cutting, scouring, and the deposition of fresh alluvium at each flooding. In some places tufts of grass and a few willow trees have established themselves. Most of the acreage is barren, and none of it is suitable for agriculture. Riverwash is in capability unit VIIIs-1.

Saline-alkali land

Saline-alkali land is a miscellaneous group of soils that has developed in areas of imperfect to poor drainage and under the influence of slight to moderate and, in places, large amounts of salts.

Saline-alkali land (Sa).—These are strongly saline soils in poorly drained swales and depressed areas and on slopes bordering small drainageways. They are flooded and seepy in wet seasons, but they are dry part of the time. When dry, the surface is coated with a white crust on which only salt-tolerant weeds and grasses grow. Areas that have good surface drainage but poor internal drainage have a brown, weakly to moderately cemented, alkali hardpan in the subsoil. Some of the soils in this mapping unit are moderately well drained and have profiles similar to those of the Demers and Tuffit soils.

A fair to moderate cover of grasses on some areas produces some forage. Areas locally called alkali flats are little more than wasteland. Some of the Demers and Tuffit soils included with this mapping unit are cultivated with the associated nonsaline soils. This mapping unit is in capability unit VIs-2.

Selle series

The Selle series consists of deep, brown, loamy soils. These soils have developed in calcareous, moderately coarse terrace and outwash deposits derived mainly from gray, green, red, and brown argillite and quartzite. The native vegetation was a dense forest of coniferous trees and a scattering of deciduous trees and shrubs with coarse grasses in the openings.

The Selle soils consist of brown fine sandy loam underlain by loamy fine sand substrata. They are noncalcareous to depths exceeding 4 feet.

These soils absorb nearly all rain that falls on them. Permeability is moderately rapid in the upper horizons and rapid in the lower horizons. Soil drainage is somewhat excessive.

The Selle soils have developed in the same kind of parent material as the Flathead soils, but the surface soil and upper subsoil are much lighter colored. The Selle soils are very similar to the closely associated and often intermingled McCaffery soils. They differ, however, in having a finer textured surface soil and subsoil.

Typical profile (Selle fine sandy loam—cultivated, 0 to 3 percent slopes, in the SW¼SW¼ sec. 28, T. 27 N., R. 19 W.):

A_p 0 to 9 inches, brown to dark-brown (10YR 5.5/3, dry; 7.5YR 3/2, moist) fine sandy loam; weak, fine, crumb structure; soft when dry, very friable when moist; slightly acid; boundary clear.

B_{21} 9 to 20 inches, pale-brown to dark-brown (10YR 6/3, dry; 3.5/3, moist) fine sandy loam; massive; soft when dry, very friable when moist; moderately acid; boundary gradual.

B_{22} 20 to 36 inches, very pale brown to brown (10YR 7/2.5, dry; 4/3, moist), light fine sandy loam grading to loamy fine sand in the lower part; soft and very friable; spots of brown to dark brown; thin seams of more clayey material that are slightly hard when dry and slightly firm when moist; slightly acid; boundary diffuse.

BC 36 to 48 inches +, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 4/2.5, moist) loamy fine sand with firm spots and seams of fine sandy loam; massive or loose and single-grained; soft when dry, very friable when moist; noncalcareous but only slightly acid.

The texture of the surface soil and the upper subsoil of the Selle soils ranges from fine sandy loam to light loam. The depth to the loamy fine sand ranges from 30 to 50 inches. In places, a little gravel occurs throughout the soil. In some places it is fairly abundant below depths of 30 to 40 inches.

Selle fine sandy loam, 0 to 3 percent slopes (Sb).—This soil occupies broad, level to very gently sloping fans and terraces.

A number of small farms and a few fairly large ones are partly, if not entirely, on this and the other Selle soil mapped in the county. Most of the cultivated areas are used for oats, barley, rye, alfalfa, tame grasses, and some wheat for grain and forage. Nearly all the yield is fed to family dairy cows and to a few beef cattle that graze on wooded and brushy pastures. A small acreage is used for raspberries and strawberries for local sale, in addition to the acreage used for vegetables and small fruits grown for the home.

The yield of all grain and forage crops is fairly low when the soil is first cultivated. Yields increase considerably as the forest litter decomposes and crop residue is added. Nitrogen is needed for most crops. This soil is in capability unit IIIs-2.

Selle fine sandy loam, 3 to 8 percent slopes (Sc).—This soil occupies the more irregular and slightly steeper parts of the Swan River terraces and bordering fans. It is closely associated with Selle fine sandy loam, 0 to 3 percent slopes, and is in the same capability unit, IIIs-2.

The potential production of this and the other Selle soil mapped cannot be accurately estimated because of the short time they have been farmed.

Somers series

The Somers series consists of deep, fine- to medium-textured, moderately well drained soils that are sandy below a depth of 2 or 3 feet. The soils are on the terraces of glacial lakes and streams in the Upper Flathead Valley Area. The parent material was derived from argillite, quartzite, and dolomitic rocks, all of the Belt geological formation. These soils developed under grasses and a scattering of ponderosa pine.

The Somers soils have a gray surface soil, 5 to 8 inches thick, a weak prismatic and blocky subsoil of about the same thickness, and a moderately to strongly developed lime carbonate horizon at the top of the parent material.

Somers soils are more clayey throughout their profile and are more poorly drained than the Kalispell

soils. In addition, the substratum below an average depth of about 30 inches is more sandy.

Typical profile (Somers silty clay loam—cultivated, in the SW¼SW¼ sec. 17, T. 27 N., R. 20 W.):

- A_{1p} 0 to 8 inches, gray to very dark gray (10YR 5/1, dry; 3/1, moist) silty clay loam; moderate, very fine, granular structure; soft when dry, very friable when moist; about neutral; boundary abrupt.
- B_2 8 to 12 inches, grayish-brown to dark grayish-brown (10YR 5.5/2, dry; 4/2, moist) silty clay loam; weak, coarse, prismatic and weak to moderate, medium, blocky structure; slightly hard when dry, friable when moist; slightly alkaline; boundary clear.
- C_{ca} 12 to 22 inches, light-gray or very pale brown to pale-brown (10YR 7/2.5, dry; 6/3, moist) silty clay loam; massive in place but breaks to weak, subangular blocks; slightly hard when dry, slightly firm when moist; calcareous, including moderate amount of segregated lime; boundary gradual.
- C 22 to 30 inches, very pale brown to pale-brown (10YR 7/3, dry; 6/3, moist), stratified or varved silt loam and silty clay loam; breaks to weak, fine, blocks; slightly hard when dry, slightly firm when moist; calcareous; boundary abrupt.
- D 30 inches +, light-gray to light brownish-gray (10YR 7/2, dry; 6/2, moist) loamy fine sand; single grained; loose; calcareous.

The texture of the B and C_{ca} horizons varies slightly in the Somers soils. The depth to the C_{ca} horizon ranges from 10 to 18 inches, and locally the B_2 horizon is slightly calcareous in its lower part. Some fields of these soils have light-colored lime spots where deep plowing in naturally thin solum or in wind-eroded spots has reached into the upper part of the C_{ca} horizon. Some areas are moderately subirrigated, which is beneficial to crops.

Somers silt loam, 0 to 3 percent slopes (Sd).—The profile of this soil is similar to the one described, but the texture of the surface soil is silt loam. The areas of this soil are nearly flat or only slightly wavy, and runoff is slow. Following heavy rains, water stands for a few hours in slight swales that are only a few inches below the general level of the soil.

As a rule, this soil is only mildly alkaline, and it contains no harmful salts. However, in places, it grades to the Tuffit and Demers soils that have a dense, strongly alkaline, claypanlike upper subsoil and moderately to strongly saline lower subsoil. In some of these places, it is heavier and less friable than normal, and in these places it has salts in the lower subsoil, but not in harmful amounts. A few areas of Tuffit soils too small to map separately are included with this soil.

Extra available moisture and a good supply of plant nutrients make this soil one of the most productive soils in the Upper Flathead Valley Area. Most of it is cultivated. Wheat is the main crop, but barley, oats, potatoes, and alfalfa are also grown. This soil is in capability unit I–1.

Somers silt loam, 3 to 7 percent slopes (Se).—Besides differing in slope, this soil has a more irregular surface than Somers silt loam, 0 to 3 percent slopes. In addition, some areas on the steeper slopes and tops of low ridges have a surface soil that is naturally thinner or has been slightly thinned by wind and water erosion. Deep plowing in these places mixes some of the light-colored, calcareous subsoil with the surface soil and causes light-colored spots in fields. This soil is used in about the same way as Somers silt loam, 0 to 3 percent slopes. It is in capability unit IIe–1.

Somers silty clay, 0 to 4 percent slopes (Sf).—Except in texture of the surface soil, this soil has a profile similar to the one described. It is in flat, or slightly depressed areas that have very slow runoff. Water usually stands on the surface for a few hours after heavy rain or when snow melts. The soil dries out a little more slowly in spring, and for this reason it is sometimes tilled too wet when used with other faster drying Somers soils. Consequently, rough and cloddy spots of this soil can be seen in fields that are otherwise smooth and in good tilth. This soil is in capability unit IIw–1.

Somers silty clay loam, 0 to 3 percent slopes (Sg).—This soil is used mainly for cultivated crops. Tillage is delayed because the soil tends to dry out late in spring and somewhat slowly after rains. It is in capability unit IIw–1.

Somers silty clay loam, 3 to 8 percent slopes (Sh).—This soil occupies small areas and narrow bands on moderate slopes, mainly in association with Somers silty clay loam, 0 to 3 percent slopes. It is used in about the same way. It is in capability unit IIw–1.

Stryker series

The Stryker series consists of moderately deep, medium-textured, somewhat poorly drained soils of glacial lake and stream terraces. The parent material was derived largely from argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. These soils developed under coniferous and deciduous trees and shrubs. Aspen now grows profusely in cutover areas and invades pastures.

The upper surface soil of the Stryker soils is a very thin, grayish-brown silty material. The lower surface soil is light gray and about 8 inches thick. The subsoil is a very pale brown silty material that has a blocky structure. The light-gray parent material is limy in the upper part.

The Stryker soils occur in association with the Half Moon, Depew, and Radnor soils. However, they show more evidence of gleying, have less distinct horizonation below the A_2 layer, are less uniformly leached of their carbonates, and are more mottled in their subsoils than these associated soils.

Typical profile (Stryker silt loam):

- A_0 3 to 0 inches, well-decomposed forest litter; lower inch matted.
- A_1 0 to 1 inch, grayish-brown to very dark grayish-brown (10YR 5/2, dry; 3/2, moist) silt loam; moderate, fine, granular structure; soft when dry, very friable when moist; slightly acid; boundary abrupt.
- A_2 1 to 9 inches, light-gray to gray (10YR 7/1, dry; 5/1, moist) silt loam; weak, medium, platy structure breaking to weak, fine, blocky structure; slightly firm in place but soft and friable when disturbed; slightly acid; boundary clear.
- A_2B 9 to 12 inches, light brownish-gray to grayish-brown (10YR 6/2, dry; 5/2, moist) silt loam; faint and prominent, fine, gray and brown mottles; weak, medium, subangular blocky structure; light-gray, thin, coating of A_2 material on peds; reaction about neutral; boundary clear.
- B_2 12 to 17 inches, very pale brown to pale-brown (10YR 8/3, dry; 6/3, moist), light silty clay loam; mottles of light yellowish brown are coarse and common, those of gray are few, faint, and fine, and those of dark brown are prominent; moderate, medium,

blocky and subangular blocky structure; hard when dry, firm when moist; reaction about neutral; weak effervescence in spots when treated with diluted hydrochloric acid; boundary clear.

C_{ca} 17 to 22 inches, light-gray to grayish-brown (10YR 7/2, dry; 5/2, moist) silty clay loam; common, faint, coarse, pale-yellow and light yellowish-brown mottles and few, fine, dark-brown mottles; massive structure in place but separates easily into weak, coarse and medium blocks; slightly hard when dry, slightly firm when moist; calcareous, including a few white spots and seams of lime carbonate; boundary clear.

C 22 to 30 inches, light-gray to light yellowish-brown (2.5Y 7/2, dry; 6/3, moist) silty and loamy parent material; thinly stratified or varved; calcareous.

Below the A_2 horizon, the Stryker soils are not uniform in thickness of horizons and depth to free lime carbonate. In some places the B_2 horizon is slightly calcareous throughout; in others there are no free carbonates above the little-altered parent alluvium.

Stryker silt loam, 0 to 3 percent slopes (Sk).—The profile of this soil is like the typical profile described. The wetter areas are used as hay meadows and pasture. The uncleared acreage is mainly in second-growth forest or is used as brushy pasture. Bluegrass and white and alsike clovers establish themselves naturally on brushy pastures and provide fair to good grazing most of the summer.

Small areas of this soil in large areas of better drained soils are farmed. This soil is drained by road ditches and shallow field ditches, and it dries out slightly more slowly than the other Stryker soils. Small grain, alfalfa, and tame-grass hay are the principal crops. This soil is in capability unit IIIw–1.

Stryker silt loam, sandy subsoil, 0 to 3 percent slopes (Sm).—This soil is less clayey and slightly browner than the soil for which the profile is given. It is underlain by loose, loamy fine sand at depths of 18 to 24 inches. It occupies poorly drained, flat or depressed areas. However, because of the loose sand substrata and the less clayey upper layers, it has better drainage than the other Stryker soils. As a result, part of this soil has been cleared and is used without artificial drainage for oats, tame grasses, and clovers. These crops are harvested as hay or as pasture. This soil is in capability unit IIIw–1.

Stryker silty clay loam, 0 to 3 percent slopes (Sn).—This soil has a profile similar to the one described, but the surface soil is slightly heavier textured. Most of the merchantable timber has been cut, and most of the acreage is in young second-growth forest. Some of the acreage is used for brushy and woodland pasture. Areas adjacent to farmsteads have been improved as pasture through the seeding of clovers and tame grasses. This soil is in capability class IIIw–1.

Swims series

The Swims series consists of deep, light-colored silty soils. These soils have developed in deep, light-colored, medium-textured, calcareous alluvium on high bottom lands and low terraces in the Upper Flathead Valley Area. The parent material was derived from argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. It has been largely reworked from glacial drift. The soils developed under a moderate to dense forest, mainly ponderosa pine and hardwoods. In general, the Swims soils are in the southern part of the Upper Flathead Valley Area, where rainfall is too low to support a good forest. Established trees, however, draw moisture from the ground water, which is generally within 4 to 10 feet of the surface.

The Swims soils have thin, dark-gray A_1 horizons, light brownish-gray A_2 horizons, and weak blocky subsoils.

These soils are finer textured than the Kiwanis soils, and they have thinner A_1 horizons and an A_2 horizon not present in the Kiwanis soils. They are deeper and less sandy than the Birch soils.

Typical profile (Swims silt loam):

A_0 1 to 0 inch, forest litter consisting of pine needles and the leaves of deciduous trees and shrubs; lower one-fourth inch matted and well decomposed.

A_1 0 to 1 inch, dark-gray to black (10YR 4/1, dry; 2/1, moist) silt loam; moderate, thin, platy and moderate, medium, granular structure; slightly hard when dry, very friable when moist; noncalcareous; boundary clear.

A_2 1 to 4 inches, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 3.5/2, moist), light silty clay loam; moderate, medium and coarse, platy structure and weak, fine and medium, subangular blocky structure; slightly hard when dry, very friable when moist; many fine pores and root channels; noncalcareous; boundary abrupt.

B_2 4 to 11 inches, pinkish-gray to brown (7.5YR 7/2, dry; 4.5/2, moist), light silty clay loam; weak, coarse, prismatic structure and fine and medium, subangular blocky structure; blocks very porous and have a few smooth faces, but surface not coated with clay; slightly hard when dry, friable when moist; thin, clay coating in root channels and wormholes; noncalcareous; boundary clear.

B_{ca} 11 to 17 inches, pinkish-gray to brown (7.5YR 7/2, dry; 5/2, moist) silt loam; weak, coarse, prismatic and thick, platy structure separating into weak, medium, subangular blocky; interior of peds faintly stained or mottled pale brown and light yellowish brown; slightly hard when dry, friable when moist; many pores and root channels, some thinly coated with clay; moderate effervescence with diluted hydrochloric acid; boundary clear.

C_{1ca} 17 to 25 inches, very pale brown to brown (10YR 7/3, dry; 5/3, moist) silt loam; few, faint, fine, yellowish-brown mottles; massive in place, except for thin, horizontal strata that break easily into fine blocks; slightly hard when dry, firm when moist; numerous fine pores and a few roots and root channels; violent effervescence with hydrochloric acid; few, fine, white segregations of lime; boundary clear.

C_2 25 to 40 inches, pinkish-white to pinkish-gray (7.5YR 8/2, dry; 6/2, moist) silt loam; massive, except for horizontal strata ¼ to ½ inch thick; firm to moderately friable when moist; calcareous but no segregated lime; boundary gradual.

C_3 40 to 54 inches, similar to horizon above but contains thin lenses of very fine sandy loam; boundary gradual.

C_4 54 to 60 inches, loamy fine sand; massive or single grained; calcareous.

Where the soils of this series are subject to occasional flooding, the thickness and distinctness of horizons and the depth to free carbonates vary with the frequency of floods. Under cultivation, the lower areas have been subject to some scouring and deposition of fresh alluvium and are calcareous in the A_p horizon. Areas of Swims soils entirely above flood levels are free of lime to depths of 6 to 15 inches unless deep plowing has brought lime to the surface. Where cultivation has mixed the A_1 and A_2 horizons, the soils are decidedly light or nearly white when dry and pinkish when moist. The

depth to the slightly sandy or stratified silty and sandy substrata ranges from 3 to 5 or more feet.

Swims silt loam, 0 to 3 percent slopes (So).—This soil has the profile described as typical of the Swims series. It is on nearly level, low terraces bordering the Flathead River. Most of it is cultivated. Wheat and small grains are the main crops; potatoes and alfalfa are also grown. The rest of this soil is used for pasture. Improved pastures can be developed mainly by cutting or reducing the number of trees left after logging. Native and tame grasses naturally seed in the open areas and provide fair grazing. This soil is in capability unit IIw–1.

Swims silt loam, 3 to 7 percent slopes (Sp).—This soil has a wavy or undulating surface because the old stream channels were not completely filled when the parent material was deposited. Except for the irregular surface and the slightly thicker surface layer in the lower part of the swales, this soil is similar to Swims silt loam, 0 to 3 percent slopes. The areas in the swales, however, stay wet a little longer in spring and may delay spring tillage. This mapping unit is in capability unit IIw–1.

Swims silty clay loam, 0 to 4 percent slopes (Sr).—This soil contains a little more clay in the surface soil and upper subsoil than Swims silt loam, 0 to 3 percent slopes. It tends to dry out a little more slowly in spring and after rains. In fields containing both soils, this soil usually is a little more cloddy or rougher after plowing than the silt loam soils. It forms larger clods either because it is harder when dry or because it has a greater tendency to puddle when too moist. This soil is in capability unit IIw–1.

Tally, Blanchard, and Flathead soils

This mapping unit is made up of three soils so closely associated that it was not practical to map them separately. These soils—the Tally, Blanchard, and Flathead—occur in irregular patterns. Blanchard very fine sandy loam and Flathead fine sandy loam have been described elsewhere in this section, under the Blanchard and the Flathead series. The description of the Tally member follows.

The Tally series consists of moderately deep, moderately sandy soils over loose sand. They have developed in glacial outwash and old stream deposits on terraces and alluvial fans, mainly north and northwest of Kalispell. The terraces and fans apparently were originally nearly level but later were partly dissected by streams. Wind drifted the material before it was stabilized and caused the nearly level, undulating, and rolling topography on which the soils occur. The native vegetation was grasses common to sandy areas and some sage.

Soils of the Tally series have a dark, moderately sandy surface soil about 10 inches thick. The subsoil is brown and moderately sandy and merges gradually with the loose sand substrata at depths of 15 to 30 inches.

These soils absorb nearly all precipitation; permeability is moderately rapid. Drainage is somewhat excessive.

Tally soils have more strongly developed profiles, including the B_2 horizon, than the Blanchard soils. They have much thinner A and B horizons and a more pronounced C_{ca} horizon than the Flathead soils.

Typical profile (Tally fine sandy loam—cultivated, 1,225 feet north and 30 feet west of southeast corner of sec. 15, T. 29 N., R. 22 W.):

A_{1p} 0 to 8 inches, dark grayish-brown to very dark brown (10YR 4/2, dry; 2/2, moist) fine sandy loam; weak, fine, crumb structure; soft, loose, and nearly single grained when dry, very friable when moist; reaction about neutral; boundary abrupt.

B_2 8 to 15 inches, brown to dark-brown (7.5YR 5/3, dry; 3/3, moist) fine sandy loam; very weak, coarse, prismatic and weak, coarse, blocky structure; soft when dry, very friable when moist; reaction about neutral; boundary clear.

C_{ca} 15 to 30 inches, light-gray to grayish-brown (10YR 7/2, dry; 5/2, moist) fine sandy loam; massive; soft when dry, friable when moist; moderate accumulation of floury lime carbonate; boundary gradual.

C_1 30 to 40 inches +, pale-yellow to grayish-brown (2.5Y 7/3, dry; 5/2, moist) loamy fine sand; massive to loose and single-grained; calcareous.

The Tally soils are dominantly fine sandy loam texture in the solum and C_{ca} horizon. However, finer and coarser lenses and strata are common at any depth. Stratification has been caused partly by deposits of alluvium, partly by the drifting and sorting of the material by wind before it was stabilized, and partly by old and recent wind erosion. Buried dark, sandy and silty strata are common to some areas. In some areas where wind erosion is active, the A_p horizon is entirely in the brown subsoil, and in others it is partly in the C_{ca} horizon. In areas where wind erosion is severe, the entire solum of soils in the general vicinity may be slightly calcareous because of recalcification by calcareous dust.

Tally, Blanchard, and Flathead soils, 0 to 3 percent slopes (Ta).—Most of this mapping unit is cultivated, mainly for wheat. If the soil is left bare, especially in spring, it may be severely eroded by wind. These soils are in capability unit IIes–1.

Tally, Blanchard, and Flathead soils, 0 to 3 percent slopes, wind eroded (Tb).—The dark surface soil of this mapping unit lacks the uniform thickness characteristic of the uneroded soils. Moderate to severe wind erosion and drifting have winnowed much of the finely divided organic matter from the soils. In places where much of the dark surface soil has been lost, some of the light-colored, calcareous subsoil is brought to the surface by tillage. This gives fields a spotted light-gray, pale-brown, and brown appearance. Where the loss of soil has been the greatest, tillage is mainly in the nearly white subsoil and the surface soil is strongly calcareous. Drifting soil and the shortage of available plant nutrients through loss of the dark surface soil cause uneven growth and reduced yields of grain. Most of these soils are cultivated and in capability unit IIes–1.

Tally, Blanchard, and Flathead soils, 3 to 7 percent slopes (Tc).—This mapping unit has a slightly irregular or hummocky relief. The dark surface soil on low ridges and hummocks in many spots is thinner than normal. Most of this mapping unit is cultivated; it is in capability unit IIes–1.

Tally, Blanchard, and Flathead soils, 3 to 7 percent slopes, wind eroded (Td).—This mapping unit differs from the Tally, Blanchard, and Flathead soils, 3 to 7 percent slopes, only in erosion. The surface soil has been blown about, drifted, and, in places, removed down to the calcareous subsoil. Erosion gives fields a spotted appear-

ance and has reduced crop yields. This complex is in capability unit IIes–1.

Tally, Blanchard, and Flathead soils, 7 to 12 percent slopes (Te).—This mapping unit occurs on hillocks, rolling ridges, and the edges of the terraces and alluvial fans where short drainageways are deeply entrenched. On ridgetops and upper slopes, the surface soil is thinner than normal.

Most of this mapping unit is cultivated with less sloping soils. Some of the rolling acreage outside of fields or along the borders of fields is not cultivated. If left bare in spring, soil on upper slopes and on exposed ridges is eroded by wind. This complex is in capability unit IIIe–1.

Tally, Blanchard, and Flathead soils, 7 to 12 percent slopes, wind eroded (Tf).—This mapping unit differs from Tally, Blanchard, and Flathead soils, 7 to 12 percent slopes, only in erosion. Freshly plowed fields have a spotted gray, brown, and dark-brown appearance. Wind erosion has removed most of the nearly black surface soil from 20 to 30 percent of the area, and all of the surface soil and part of the brown subsoil from about 10 percent. In the most severely eroded spots, tillage is in the calcareous, nearly white, lower subsoil. Crop yields have been severely reduced. This complex is in capability unit IIIe–1.

Tally, Blanchard and Flathead soils, 12 to 20 percent slopes (Tg).—This mapping unit has dunlike relief and is on the steep borders of terraces where short streams are deeply entrenched. The soils on about half of the acreage have profiles similar to the typical profiles described for the Tally, Blanchard, and Flathead soils. Over the rest, the surface soils have been thinned somewhat by wind erosion, or they were never quite so thick as those of the typical profiles.

Most of this mapping unit is in native pasture and is relatively uneroded. Small cultivated areas are severely eroded. This complex is in capability unit IVe–1.

Tuffit-Somers complex

This complex consists of intermingled areas of Tuffit and Somers soils that could not be feasibly mapped separately. Tuffit silty clay loam, described under the Kalispell-Tuffit complex, comprises 50 percent or more of the complex. The rest is Somers silty clay loam, described under the Somers series.

Tuffit-Somers silty clay loams, 0 to 5 percent slopes (Th).—This is the only mapping unit in this complex. Included with it are a few small, undulating and gently sloping areas.

Nearly all of this complex is cultivated, mainly for small grain. Where claypan subsoil has been brought up in tillage, the fields contain numerous rough, cloddy spots. Because of poor tilth, poor moisture relations, and crusting, the germination of small grains is usually poor and yields are low. In dry years the grain on some of the clay spots may fail to mature. This complex is in capability unit IIIs–4.

Waits series

The Waits series consists of moderately deep, silty soils containing many stones and boulders. The parent material is silty and loamy glacial till containing a large percentage of rock fragments. The coarser material was derived mainly from quartzite, and the fine material from quartzite and argillite. Dolomite and limestone fragments are in the lower part of the subsoil and substrata. The native vegetation is mainly Douglas-fir, balsam fir, and western larch and an undergrowth of shrubs and woody plants in the more open places. Native and tame grasses readily establish themselves when cutover areas are used for pasture.

Waits soils readily absorb moisture and have little erosion. They are well drained except in the glacial potholes and depressions.

The soils of the Waits series are covered in most places by a mat of forest litter about 2 to 4 inches thick. The surface soil is gray, thin, and generally silty. It contains many stones and boulders. The subsoil is yellowish brown, silty, and massive. It also contains many stones and boulders.

The Waits soils have developed from more finely textured parent material than the Krause soils, which have loose, sandy, gravelly, and stony lower subsoils and substrata.

Typical profile (Waits silt loam, about 800 feet northeast of the southwest corner of sec. 35, T. 28 N., R. 19 W.):

A_0 1½ to 0 inches, loose, undecomposed needles, leaves, and grass in the upper 1 inch; well-decomposed, dark-brown, matted material with fine roots in the lower one-half inch; boundary abrupt.

A_2 0 to ¼ inch, gray to dark-gray (10YR 5.5/1, dry; 4/1, moist) silt loam; moderate, fine, platy structure; slightly hard when dry, very friable when moist; slightly acid; boundary abrupt.

B_{21} ¼ to 5 inches, yellowish-brown to dark-brown (10YR 5/4, dry; 7.5YR 3/4, moist) silt loam; massive structure; slightly firm in place but loose and fluffy if disturbed when dry; slightly acid; boundary clear.

B_{22} 5 to 18 inches, light yellowish-brown to dark-brown (10YR 6/4, dry; 7.5YR 3/4, moist) silt loam; massive; slightly firm in place but loose and fluffy if disturbed when dry; slightly acid; boundary gradual.

C_1 18 to 26 inches, light-gray to gray (10YR 7/2, dry; 5/1, moist) silt loam; leached and weakly weathered glacial till.

C_2 26 inches +, light-colored, moderately compact glacial till.

Coarse fragments, up to boulders in size, make up 10 to 20 percent of the volume of Waits soils. Numerous stones are on the surface in most areas. Small areas of darker colored soils containing more organic matter have developed in small potholes and depressions.

Waits cobbly silt loam, fans, 0 to 3 percent slopes (Wa).—This soil occupies broad, nearly level and gently sloping outwash fans formed by water from melting glaciers near the foot of the mountains along the east side of the valley. The surface soil is slightly darker than that of the typical profile. In addition, many large stones are on and in the soil.

Most of this soil is in forest. Some areas around farmsteads have been cleared of most trees and are used as brushy pastures. A few cleared patches are used for home gardens or for winter forage for family dairy cows and a few beef cattle. The large stones would have to be removed to make this soil suitable for extensive farming with modern equipment. This soil is in capability unit IVs–4.

Waits cobbly silt loam, fans, 3 to 7 percent slopes (Wb).—This soil has more stones on the surface and is

slightly thinner on slope breaks than the soil described. It is on ridged, channeled, and somewhat hummocky parts of alluvial fans and the sloping, dissected edges of fans. Except for a few small areas cleared for brushy pasture, this soil is in cutover and second-growth forest. It is in capability unit IVs–4.

Waits silt loam, 0 to 7 percent slopes (Wc).—This soil occurs on widely scattered, small areas on the smooth parts along the foot of Swan Mountain. It is free of large stones to a depth of about 20 inches. Most of it is in forest. A small acreage is cultivated, but yields are generally low because of the low amount of organic matter and the lack of available nitrogen. Mild relief and favorable physical properties make the soil well suited to cultivation. It is in capability unit IIs–1.

Waits silt loam, fans, 0 to 4 percent slopes (Wd).—This soil occupies widely scattered, small to fairly large acreages within larger areas of the more stony soils on nearly level outwash fans. Most of the soil is in cutover or second-growth forest. Small, cleared areas around farmsteads are used for gardens and hay meadows or for pasture. If cleared, this soil is suitable for cultivation, but many areas occur within larger areas of soils that are best suited to forestry. This soil is in capability unit IIs–1.

Waits stony silt loam, 0 to 7 percent slopes (We).—This soil is on the gently sloping parts of the mountain foot slopes. It has more stones on the surface and in the soil than Waits silt loam, 0 to 7 percent slopes. Most of this soil is in forest, but a small part has been cleared for forage crops and pasture. The many large stones prevent extensive farming. The soil is in capability unit Vs–1.

Waits stony silt loam, fans, 0 to 7 percent slopes (Wh).—This soil is on gently sloping fans near the foot of the mountains. It is similar to Waits stony silt loam, 0 to 7 percent slopes, but it receives more moisture and is slightly better for plant growth. All of this soil is in forest. Although the soil is well situated for farming and has good moisture relations, it cannot be successfully farmed unless the large stones are removed. It is in capability unit Vs–1.

Waits stony silt loam, 7 to 12 percent slopes (Wf).—This soil has more stones on the surface and throughout than Waits silt loam, 0 to 7 percent slopes. It is on the moderately sloping and rolling parts of mountain foot slopes. Some less sloping and some steeper areas of Waits soils are included.

Except for small clearings around farmsteads, Waits stony silt loam, 7 to 12 percent slopes, is in forest. Some of the large trees have been cut for lumber. This soil is too steep and stony for cultivation; it is in capability unit VIe–1.

Waits stony silt loam, 12 to 35 percent slopes (Wg).—This soil is on the steeper and more rugged slopes adjoining the very steep, broken and rough mountains and some steep-sided canyons lower on the mountains. Some areas have a steep, hummocky, and hilly relief caused by the irregular deposition of the parent till and the cutting by streams at the time the till was deposited. On some of the steeper slopes, the profile of this soil is not quite so thick as that described as typical.

All of this soil is in forest consisting mainly of good to excellent stands of young trees. Original forest covers some of the acreage. The soil is too steep and rugged for tillage, and it is in capability unit VIe–1.

Waits-Krause complex

This complex consists of small areas of Waits stony silt loam and Krause gravelly loam, that are too intricately associated to be mapped separately. Both soils have been described in this section.

Waits and Krause stony loams, 0 to 7 percent slopes (Wk).—This mapping unit is in cutover and second-growth timber. It is stony and droughty and not suited to cultivation. It is in capability unit Vs–1.

Waits and Krause stony loams, 7 to 12 percent slopes (Wm).—This mapping unit is on hummocky and irregular slopes. In some swales and sags, the soils are deeper and less stony than elsewhere. Nearly all of the acreage is in forest. Much of the larger timber has been cut, but virgin forest is on some of the acreage. This complex is in capability unit VIe–1.

Waits and Krause stony loams, 12 to 40 percent slopes (Wn).—This mapping unit occurs as fairly large continuous areas on high valley slopes or on mountain foot slopes in the vicinity of Lake Blaine, as well as elsewhere south and north of this general location. Some of the acreage is a moderately sloping moraine having rough local relief caused by numerous deep, small kettle holes. Other places are steep terminal moraines that were gullied and scoured by glacial runoff where the till was deposited. None of this complex is suitable for farming. It is in capability class VIe–1.

Walters series

The Walters series consists of moderately deep, light-colored, moderately sandy soils on low terraces bordering the larger streams. These soils have developed in stratified, medium and moderately coarse alluvium, mainly reworked from glacial drift. The alluvium was derived from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The original vegetation was a mixture of coniferous and deciduous trees, dominated by Douglas-fir, larch, ponderosa pine, and lodgepole pine.

The Walters series have a gray to brown surface soil about 10 inches thick. They have a pale-brown loamy subsoil with only a weak structure. The Walters soils are more sandy below a depth of 2 feet and grade into stratified sandy loams and sands.

These soils are well drained, and the moisture-holding capacity is somewhat limited by coarse substrata. In places the water table fluctuates, and it may rise to within 3 or 4 feet of the surface in seasons of heavy rain, melting snow, and high water in streams.

The Walters soils differ from the Swims soils in having slightly less silt and clay in the surface and upper subsoil layers and more sand in the lower subsoil and substrata. They differ from Kiwanis soils mainly in having lighter colored and more acid surface soils.

Typical profile (Walters very fine sandy loam—cutover, brushy pasture—in the NE¼NE¼ sec. 4, T. 29 N., R. 21 W.):

A_{00} 2 to 0 inches, loose mat of fairly fresh conifer needles.

A_1 0 to 2 inches, gray to very dark brown (10YR 4.5/1, dry; 2/2, moist) very fine sandy loam; weak, fine, crumb structure; loose and single grained when dry, very friable when moist; slightly acid; boundary abrupt.

A_2 2 to 10 inches, very pale brown to pale brown (10YR 7/3, dry; 6/3, moist) very fine sandy loam; massive to weak, coarse, platy structure; hard when dry, very friable when moist; slightly acid; boundary clear.

B_2 10 to 13 inches, pale-brown to dark-brown (10YR 6/3, dry; 7.5YR 3/3, moist) silt loam; weak, subangular blocky structure; slightly hard when dry, but centers of peds are hard and slightly darker; friable when moist, but centers of peds are firm; about neutral in reaction; boundary clear.

B_{ca} 13 to 24 inches, pale-brown to brown (10YR 6.5/3, dry; 7.5YR 4/3, moist) fine sandy loam; massive, except for the presence of a few, firm or hard, small lumps; soft when dry, friable when moist; calcareous; boundary clear.

C 24 to 34 inches, light-gray to pale-brown (10YR 7/2, dry; 6/3, moist) fine sandy loam; massive; soft when dry, very friable when moist; calcareous; has a few, fine, firm spots of segregated lime carbonate; grades to coarse sand at depths of 3 to 4 feet.

Variations in the Walters soils are chiefly in the thickness of horizons and in the depth to free lime carbonate. In some places the soils are weakly calcareous immediately below the A_2 horizon. In some places in plowed fields, they are calcareous in the A_p horizon. The A_1 horizon is from 1/4 to 1/2 inch thick, and in places it is barely visible. Locally a sprinkling of fine- and medium-sized gravel occurs in all horizons and stratified sand and gravel occur below depths of 3 to 4 feet.

Walters silt loam, 0 to 4 percent slopes (Wo).—This soil contains a little more silt and clay in the surface soil than the soil for which the profile was given. In addition, its upper subsoil is a little browner, and the fine sandy loam subsoil extends a little deeper.

About half the acreage has been cleared, and more is being cleared. The main crops are small grain and alfalfa. The forested acreage has been logged, and most of the large trees cut for timber. Open stands of trees are on the cutover areas. This soil is in capability unit IIs–1.

Walters very fine sandy loam, 0 to 7 percent slopes (Wp).—This soil is on slightly rolling topography. It has the profile described as typical. It is used in about the same manner as Walters silt loam, 0 to 4 percent slopes, and it is in capability unit IIs–1.

Whitefish series

The Whitefish series consists of deep, well-drained, light-colored, silty soils containing some gravel and underlain by gray, calcareous till. The areas occur along the north and west sides of the Upper Flathead Valley Area and in some places extend out into the valley in the general area south and west of Whitefish. Smaller areas are in the valley.

These soils have developed from calcareous, medium-textured, glacial till containing a large percentage of round gravel, cobbles, and large stones. This material was derived from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The native vegetation is a dense forest of ponderosa pine and Douglas-fir, some birch and aspen, and a scattering of balsam fir and white pine. In less dense forests, the understory is a heavy growth of serviceberry, huckleberry, Oregon-grape, kinnikinnick, and coarse grasses.

These soils have a light-gray to almost white surface soil, about 8 inches thick. The subsoil is a light-brown silty material with a blocky structure.

The Whitefish soils are lighter colored and have more clayey subsoil than the Prospect soils. The depth to free lime is greater.

Typical profile (Whitefish gravelly silt loam, in the SE1/4SW1/4SE1/4 sec. 12, T. 30 N., R. 22 W.):

A_0 1 to 0 inch, mottled, well-decomposed forest litter, dark-brown in the lower 1/2 inch; many roots along the lower boundary; acid reaction; boundary abrupt.

A_{21} 0 to 1 inch, light-gray to dark grayish-brown (10YR 7/1, dry; 4/2, moist) gravelly silt loam; weak, fine, platy structure breaking easily to a moderate, fine, crumb structure; soft when dry, very friable when moist; many very fine, dark-brown concretions; acid reaction; boundary abrupt.

A_{22} 1 to 2 inches, light-gray to grayish-brown (10YR 7/2, dry; 5/2.5, moist) gravelly silt loam; structure similar to that of horizon above; boundary clear.

A_{23} 2 to 8 inches, white to grayish-brown (10YR 8/1.5, dry; 5.5/2.5, moist) gravelly silt loam; strong, fine, platy and moderate, fine crumb structure; vesicular; slightly hard when dry, very friable when moist; many roots and many dark, very fine concretions; very acid; boundary clear.

A_2B_2 8 to 13 inches, light-gray to light brownish-gray (10YR 7/1, dry; 6/2, moist) gravelly silt loam; brown spots of B_2 surrounded by A_2 gives the mixed soil a brown color when crushed; massive but separates to weak, subangular, blocky structure when disturbed; slightly hard when dry, friable when moist; many fine pores and root channels and a few, fine roots; many very fine, dark-brown concretions; very acid; clear wavy boundary.

B_2 13 to 19 inches, very pale brown to brown (10YR 7/3, dry; 5/3, moist), gravelly, heavy silt loam; dark-brown to brown (10YR 4/3 to 5/3) when wet and crushed; moderate, medium, subangular blocky structure; broken blocks are marbled with gray, yellowish brown, and dark brown; hard when dry, firm when moist; few, fine pores and root channels; fine roots common; noncalcareous; boundary abrupt.

19 to 19½ inches, a continuous, brown mat of dead and living roots mixed with a little soil; neutral reaction; boundary abrupt.

C_{ca} 19½ to 32 inches, light-gray (10YR 7/1, moist) silt loam, marbled with gray and yellow; light brownish gray when wet and crushed; massive in place but breaks into weak, medium, subangular blocks or lumps; hard when dry, firm when moist; a few dead and living roots; calcareous; has some segregated, soft, floury lime carbonate; boundary gradual.

C 32 to 40 inches, gray, little altered, gravelly and stony, calcareous silt loam till; firm in place but friable; a few roots occur in local masses, and the adjacent soil material commonly is stained yellow or brown.

Except for the wide range in the amount and size of stone fragments on and in the soil, the Whitefish soils vary within fairly narrow limits. Where they grade into or merge with the Waits soils, the upper part of the A_2 horizon is pale yellow or brownish. Soils with slopes of 15 to 25 percent have a solum about as thick as the less sloping soils. Those with slopes greater than 25 percent have horizons and a solum less uniform in thickness.

Whitefish cobbly silt loam, 0 to 7 percent slopes (Wr).—This soil (fig. 17) has more large stones on the surface than the soil for which the profile is given.

Most areas are in second-growth, cutover forest. Very little of the soil is cultivated. A large percentage is used as woodland pasture. Some of the pastured areas were burned following logging to remove forest debris, check

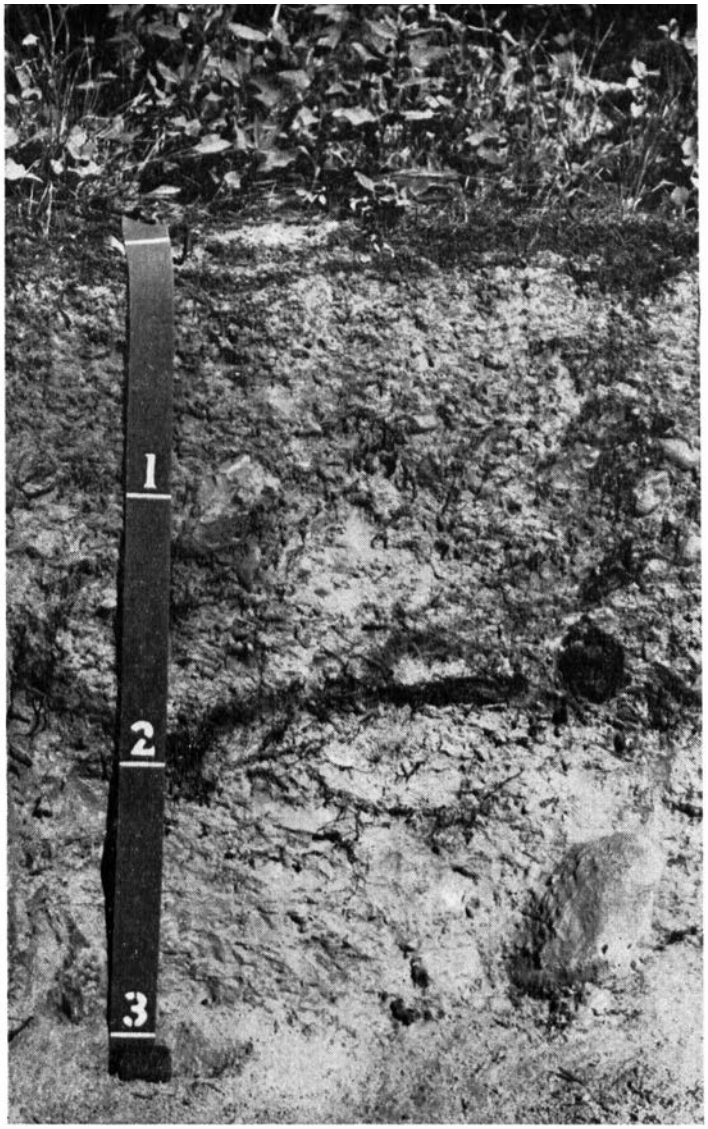

Figure 17.—**Profile of Whitefish cobbly silt loam. The wavy, dark mat of roots at the depth of 2 feet marks the bottom of the solum and the abrupt change to the C_{ca} horizon. Large stones on the soil surface are not shown.**

reforestation, and promote the growth of grasses. This soil is in capability unit Vs–1.

Whitefish cobbly silt loam, 7 to 12 percent slopes (Ws).—This soil is all in forest, some of which is used as pasture. It is in capability unit VIe–1.

Whitefish cobbly silt loam, 12 to 20 percent slopes (Wt).—This soil has more cobbles and stones on the surface than the less sloping phase of Whitefish cobbly silt loam. Most of the acreage is covered by young forests of good quality. A small acreage is in virgin forest. This soil is in capability unit VIe–1.

Whitefish cobbly silt loam, 20 to 45 percent slopes (Wu).—This soil is adjacent to mountains. In places bedrock is only 2 to 4 feet below the surface. On some of the ridge points and steep canyon sides it is exposed. This soil is in forest and in capability unit VIe–1.

Whitefish gravelly silt loam, 0 to 7 percent slopes (Wv).—This soil is mainly on gentle slopes, but about 15 percent of it is nearly level. In agricultural communities, nearly all of this soil is farmed. Small grain and alfalfa, tame grasses, and clover for hay are the principal crops. The soil is in capability unit IIIe–2.

Whitefish gravelly silt loam, 7 to 12 percent slopes (Ww).—Most of this soil is cultivated. Some of the acreage was originally cobbly or stony, but the large stones were removed to allow cultivation. The surface is now gravelly. The soil is in capability unit IIIe–2.

Whitefish gravelly silt loam, 12 to 25 percent slopes (Wx).—This soil is not suitable for cultivation, and most of the acreage is in forest or woodland pasture. This soil is in capability unit VIe–1.

Whitefish silt loam, 0 to 3 percent slopes (Wza).—This soil has a profile similar to the one described for the series, but it has less stone and gravel in the surface soil. It occurs in small areas within stony or cobbly soil but in spots where the till parent material contains only a few coarse fragments. Some of this soil was originally cobbly or stony, but enough stones were removed to justify mapping the soil as nonstony. Some gravel and a few large stones are on the surface, but not enough to interfere with farm machinery. Most of the soil is cultivated, mainly for small grain and alfalfa. The soil is in capability unit IIs–1.

Whitefish silt loam, 3 to 7 percent slopes (Wzb).—This soil is similar to Whitefish silt loam, 0 to 3 percent slopes, except in slope. In agricultural areas, the soil is cultivated; other areas are in forest. This soil is in capability unit IIIe–2.

Whitefish silt loam, 7 to 12 percent slopes (Wzc).—This soil has rolling to steep relief but is otherwise like Whitefish silt loam, 0 to 3 percent slopes. In agricultural areas, it is cultivated or used as pasture or hay meadow. It is in capability unit IIIe–2.

Whitefish silt loam, 12 to 35 percent slopes (Wzd).—This soil has irregular and steep slopes. It is in second-growth forest or is used as woodland pasture. It is in capability unit VIe–1.

Whitefish stony silt loam, 0 to 7 percent slopes (Wze).—This soil has a profile similar to the one described, but many large stones and boulders are on the surface and in the soil. Because of the stones, most of the acreage has been left in young, cutover forest of good quality. The soil is in capability unit Vs–1.

Whitefish stony silt loam, 7 to 12 percent slopes (Wzf).—This soil has large stones and boulders on the surface and in the soil. It is on moderately steep and irregular slopes.

Because of large stones on the surface, most of this soil, after logging, was allowed to revert to second-growth forest. Few areas have been thinned or cleared to improve pasture. This soil is in capability unit VIe–1.

Whitefish stony silt loam, 12 to 20 percent slopes (Wzg).—This soil differs only in slope from Whitefish stony loam, 7 to 12 percent slopes, and it is used in about the same way. It is in capability unit VIe–1.

Whitefish stony silt loam, 20 to 45 percent slopes (Wzh).—This soil differs from Whitefish stony silt loam, 7 to 12 percent slopes, in slope and in having more large stones and boulders on the surface and in the soil. It is in second-growth forest and in capability unit VIe–1.

Yeoman series

The Yoeman series consists of deep, medium-textured soils of grasslands and transitional areas between grasslands and forest. The parent material is light-colored, medium-textured, calcareous till derived mainly from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The soils developed under dense stands of mixed grasses. Along the border of the densely forested soils of other series, single trees and open and dense stands of ponderosa pine and some larch are mixed with the grass.

These soils have a thick, very dark grayish-brown surface soil. They have a weak, prismatic brown subsoil and a zone of accumulated soft, floury lime carbonate.

The Yeoman soils are well drained and moderately permeable. Runoff is slow except on the steeper slopes.

The soils of this series are more deeply leached and have thicker surface and subsoil horizons than the Creston soils. They have much thicker dark upper horizons and deeper profiles than the Prospect soils.

Typical profile (Yeoman silt loam—cultivated, in the SW¼NE¼ sec. 28, T. 29 N., R. 20 W.):

A_{1p} 0 to 10 inches, very dark grayish-brown to black or very dark brown (10YR 3/2, dry; 2/1.5, moist) silt loam; high in organic matter; moderate, very fine, granular structure; soft when dry, very friable when moist; acid reaction; boundary abrupt.

A_{12} 10 to 16 inches, dark brown to very dark brown (7.5YR 3.5/2, dry; 2/2, moist) silt loam; weak, very coarse, prismatic and moderate, very fine, granular structure; soft when dry, very friable when moist; acid reaction; boundary clear.

B_2 16 to 26 inches, light-brown to brown (7.5YR 6/3, dry; 4/3, moist) gravelly loam; weak, coarse, prismatic structure separating to moderate, fine, blocky structure; soft when dry, friable when moist; boundary clear.

C_{ca} 26 to 34 inches +, white to very pale brown (10YR 8/2, dry; 7/3, moist) gravelly and stony silt loam; massive in place, but separates into weak, fine, subangular blocks or lumps when disturbed; calcareous; has abundant, fine, floury lime segregation.

The dark surface horizons of the Yeoman soils vary somewhat in thickness, and the depth to the calcareous layer ranges from 20 to 30 inches. In some places wind erosion has thinned the surface soil.

Yeoman cobbly loam, moderately deep over sand, 0 to 3 percent slopes (Ya).—This soil occurs mainly on the west side of the valley. Except for the large amount of cobbles in the surface soil and subsoil, it has a profile similar to the one described. Very gravelly sand occurs at a depth of about 2 feet. About 15 percent of the surface soil and upper subsoil consists of stone fragments. Loose stones on the surface interfere with tillage and harvesting, but they do not prevent the use of modern farm machinery. This soil is droughty because the sand substratum holds little water. About half of this soil is cultivated, mainly for wheat. It is in capability unit IIIs–1.

Yeoman cobbly loam, moderately deep over sand, 3 to 7 percent slopes (Yb).—This soil differs from the more nearly level Yeoman cobbly loam in having steeper and more irregular slopes. Its use is about the same, and it is in capability unit IIIs–1.

Yeoman cobbly loam, moderately deep over sand, 7 to 12 percent slopes (Yc).—This soil is on moderate and rolling slopes bordering drains and on irregular, hummocky slopes. Otherwise it is similar to the more nearly level Yeoman cobbly loam.

Some water is lost through runoff during heavy rains and when snow melts rapidly. Grasses are thin and grow slowly because of the droughtiness of the soil. About one-third of the acreage is cultivated. The rest is in grass and is used for pasture or hay. The soil is in capability unit VIe–1.

Yeoman cobbly loam, moderately deep over sand, 12 to 25 percent slopes (Yd).—This mapping unit includes all of the cobbly loam soils in the Yeoman series that are on slopes of more than 12 percent and are underlain by very sandy material. The dark surface soil is only about 6 inches thick, and loose gravel is at a depth of about 14 inches. Runoff is moderate to high, and the soil is droughty. Most of the acreage is used for pasture. This soil is in capability unit VIe–1.

Yeoman gravelly loam, 0 to 7 percent slopes (Ye).—This soil has more gravel in the surface soil; otherwise its profile is like the one described for the Yeoman series. Areas of this soil included in farms are cultivated. The soil is in capability unit IIe–1.

Yeoman gravelly loam, 7 to 12 percent slopes (Yf).—The profile of this soil is similar to the one described as typical. There are, however, a fair amount of gravel and a few large stones on the surface, as well as a few more stones in the soil. Areas in farms are cultivated. The large stones interfere somewhat with tillage, but they do not reduce soil productivity. The soil is in capability unit IIIe–1.

Yeoman gravelly loam, 12 to 30 percent slopes (Yg).—This mapping unit includes all the gravelly Yeoman soils that are mostly too steep for continuous cultivation. It differs from Yeoman gravelly loam, 7 to 12 percent slopes, in slope and in having a slightly thinner surface soil. Most of this soil is in grass and used as pasture. The soil is in capability unit VIe–1.

Yeoman gravelly loam, moderately deep over sand, 0 to 3 percent slopes (Yh).—The profile of this soil differs from the one described as the typical profile in having more gravel in the surface soil and a few larger stones throughout, and in being underlain by a gravelly sand substratum at a depth of about 2 feet. The larger stones have been removed to allow tillage and harvesting, and all the acreage is cultivated. The sandy substratum makes the soil droughty. This soil is in capability unit IIIs–1.

Yeoman gravelly loam, moderately deep over sand, 3 to 7 percent slopes (Yk).—Except for slopes, this soil is like the soil described in the foregoing paragraph. It is in capability unit IIIs–1.

Yeoman gravelly loam, moderately deep over sand, 7 to 12 percent slopes (Ym).—This soil occupies slopes adjacent to streams and low hummocky areas where surface drainage is mainly into kettle holes or depressions. The surface soil is more gravelly and slightly thinner than that described in the typical profile. Gravelly sand occurs at a depth of about 2 feet. Erosion is moderate on some of the ridgetops and steeper slopes.

Most of this soil is cultivated. It is in capability unit VIe–1.

Yeoman gravelly loam, moderately deep over sand, 12 to 20 percent slopes (Yn).—This soil occurs where the parent till was deposited in irregular, low hills over

coarse sands. In places the coarse sand is as little as 12 inches below the surface. Between ridges and knobs are numerous kettle-hole basins and swales. In swales the dark surface soil is as much as 16 inches thick in places, and the coarse sand is as much as 30 inches below the surface. Small areas are farmed, but most of the acreage is in grass and is used as pasture or hay. The soil is in capability unit VIe–1.

Yeoman gravelly loam, moderately deep over sand, 20 to 40 percent slopes (Yo).—This soil has a thin surface soil, and the coarse sand is only about 1 foot below the surface. The soil is used for pasture, and it is in capability unit VIe–1.

Yeoman loam, moderately deep over sand, 0 to 3 percent slopes (Yp).—This soil has a slightly sandier surface soil than described in the typical profile and a coarse sand substratum at a depth of about 2 feet. Most of the soil is cultivated, but coarse sand makes the soil slightly droughty. This soil is in capability unit IIe–2.

Yeoman loam, moderately deep over sand, 3 to 7 percent slopes (Yr).—This soil is largely in cultivation. It is in capability unit IIe–2.

Yeoman loam, moderately deep over sand, 7 to 12 percent slopes (Ys).—This soil is hummocky and moderately sloping. Wind and water have eroded the steeper slopes and exposed ridges. About one-third of this soil is cultivated. The rest is in grass and is used mainly as pasture. This soil is in capability unit IIIe–1.

Yeoman silt loam, 0 to 7 percent slopes (Yt).—This soil is described by the typical profile. The scattered trees have been largely removed, and most of this soil is now cultivated. Small grains and alfalfa are the principal crops, but some potatoes and garden vegetables are also grown. This soil is in capability unit IIe–1.

Yeoman silt loam, 7 to 12 percent slopes (Yu).—This soil is on rolling slopes but is otherwise like Yeoman silt loam, 0 to 7 percent slopes. In some spots the surface soil has been thinned by wind and water erosion. Most of this soil is in cultivation. It is in capability unit IIIe–1.

Yeoman silt loam, 12 to 20 percent slopes (Yv).—This mapping unit includes all the Yeoman silt loam having slopes of more than 12 percent. The dark surface soil is slightly thinner on the ridgetops and steeper slopes than elsewhere. Most of this soil is in grass and is used as pasture. It is in capability unit IVe–1.

Yeoman stony loam, 0 to 7 percent slopes (Yw).—This soil has many medium and large stones on the surface and in the soil. Because of the large number of stones, this soil is used as pasture. It is in capability unit Vs–1.

Yeoman stony loam, 7 to 12 percent slopes (Yx).—This soil is similar to Yeoman stony loam, 0 to 7 percent slopes, except in slopes. It is used as pasture and is in capability unit VIe–1.

Yeoman stony loam, 12 to 35 percent slopes (Yy).—This soil is hilly to steep, and it is suitable only for pasture. It is in capability unit VIe–1.

Yeoman stony loam, moderately deep over sand, 0 to 7 percent slopes (Yza).—This soil has many large stones on the surface and in the profile. It is underlain by coarse sand at a depth of about 2 feet. Some of this soil is cultivated with adjoining less stony soils, and the rest is in pasture. The large stones have been removed from cultivated areas or placed in piles. This soil is in capability unit Vs–1.

Yeoman stony loam, moderately deep over sand, 7 to 20 percent slopes (Yzb).—This soil is moderately steep. In some spots the dark surface soil is slightly thinner than that of Yeoman stony loam, moderately deep over sand, 0 to 7 percent slopes. Most of this soil is used as pasture and is in capability unit VIe–1.

Yeoman stony loam, moderately deep over sand, 20 to 35 percent slopes (Yzc).—This soil is steep to very steep. The surface soil is thinner than that of the Yeoman soils on the more gentle slopes. Runoff is rapid during heavy rainfall and rapid melting of snow. As a result, less moisture is available for grass and the grazing capacity of pastures is lowered. This soil is in capability unit VIe–1.

Genesis, Classification, and Morphology of Soils

The purpose of this section is to present the outstanding morphologic characteristics of the soils of the Upper Flathead Valley Area and to relate them to the factors of soil formation. Physical and chemical data are limited for these soils, and the discussion of soil genesis and morphology is correspondingly incomplete. The first part of the section deals with the environment of the soils; the second, with the classification of soils, and the third, with the morphology of the soils.

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent materials; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material.

Climate and vegetation are active factors of soil genesis. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. It may be much or little, but some time is always required for horizon differentiation. Usually a long time is required for the development of distinct horizons.

The factors of soil genesis are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

The Upper Flathead Valley Area consists of low, fairly recently deposited alluvial land along the major

streams; of adjacent high lacustrine and stream-laid benches; of rolling, glacially deposited hills; and of numerous outwash slopes and aprons extending from the Swan Mountains. The Area has been glaciated one or more times. According to geologists, the latest glaciation occurred in the Wisconsin age. The Flathead Glacier was the main ice flow that moved south through the Upper Flathead Valley Area. This was one of the main lobes extending from the Cordilleran ice field that centered in British Columbia. Several local glaciers joined the main ice flow along the east side of the valley.

Apart from the thick, organic deposits in depressions, the parent material of the soils is of glacial origin or it is alluvium deposited in the postglacial period. It includes glacial till, fluvioglacial and glaciolacustrine valley fill, and recent alluvium along the Flathead River and some of its larger tributaries that are entrenched in the older valley fill. All of the materials originated mainly from rocks of the Belt formation, which consists of gray, green, brown, and reddish argillite and quartzite rock interbedded with dolomitic limestone.

The little modified till of the recessional moraines is medium textured, friable, light colored, and calcareous; it contains moderate to fairly large amounts of coarse fragments. The partly water-sorted till of the lateral and terminal moraines is noticeably coarser. Below depths of 20 to 30 inches, this material is mainly coarse fragments with loamy sand and sand in the interstices.

Near the moraines, particularly along the east side of the valley, the outwash contains a moderate to high proportion of cobbles and gravel, which are mixed with coarse- to medium-textured fine earth. As distance from the source increases, the material grades from coarse to medium in texture and eventually merges with the moderately fine, varved or thinly stratified, glaciolacustrine sediment of the valley floor. Where the glacial outwash, or alluvium, contained a high proportion of fine sand, it was winnowed and drifted into local undulating to moderately steep, dunelike areas before it was stabilized by vegetation.

The outwash, or alluvium, was deposited in a complex pattern of textures and strata because (1) the water flowed into the valley from glaciers in many locations, (2) the currents of water mixed, and (3) there were wide differences in the size of the particles in the sediment deposited. In addition, the sediments were subsequently modified by wind, water, and local climate. The soil pattern over much of the valley is, therefore, extremely complex.

Climate

The climate of the Upper Flathead Valley Area is continental and typical of that in the intermountain valleys of the Pacific slope. It is characterized by abundant sunshine, low relative humidity, comparatively low rainfall, and wide variation in daily and seasonal temperature. Low rainfall and long, cold winters have affected the development of soils. They slow the leaching process that moves clay and other materials downward in the soil profile. Differences among the soils are partly the result of differences in climate and vegetation within the Area.

Plant and animal life

Trees, shrubs, grasses, and other herbaceous plants, micro-organisms, earthworms, and various other forms of plant and animal life live on and in the soil and influence the direction and rate of soil genesis. The kinds of plants and animals that live in and on the soil are determined by the environment—climate, parent material, relief, age of the soils, and associated organisms. The influence of climate is most apparent, but it is not always so important as the kinds of microflora that grow in well-drained, well-developed soils. Nevertheless, climate has a powerful, indirect influence on the morphology of soils.

Plants and animals largely determine the kinds of organic matter added to the soil and the way in which it is incorporated with the soils. Organic material is added to soil as dead leaves, roots, and entire plants. Most of it is added to the A horizon, where it is acted upon by micro-organisms, earthworms, and other forms of life and by chemicals in the soil and in the plant remains. The general effect of plants and animals on soils is known, but the specific influences of the various species or groups of related species is not known.

The soils of the Upper Flathead Valley Area have formed under moderate to dense stands of grass and trees. Small areas and narrow belts of soils along the forest-grassland border reflect the influence of mixed types of vegetation. Former dark grassland soils are bleaching out under the encroachment of forest. However, for the most part, the transition from modal grassland to modal forest soils is fairly narrow.

Relief

The effects of climate and vegetation are modified to varying degree by the relief, as it influences exposure to sun and wind, drainage of water over and in the soil, the rate of erosion, and the kinds and amounts of plant and animal life on and in the soil. The relief, or lay of the land, in the Upper Flathead Valley Area ranges from nearly level in the poorly drained bogs to steep on the well-drained mountainsides.

Time

The development of soil profiles requires time, usually long periods. The degree of profile development depends on the intensity of the different soil-forming factors, on the length of time they have been active, and on the nature of the materials from which the soils were derived. Differences in the length of time that geologic materials have been in place are, therefore, commonly reflected in the distinctness of horizons in the soil profile.

If the soil-forming factors have not operated long enough for a soil to be in equilibrium with its environment, the soil is considered young, or immature. Soils that have been in place for a long time and have approached equilibrium with their environment are considered mature, or old.

Classification of Soils by Higher Categories

Soils are classified in categories that are progressively more inclusive. The lowest categories commonly used in the field are the series, type, and phase. Soil series are

grouped in higher categories of classification, called soil orders and great soil groups. The soil order is the highest, or most inclusive, category of classification. In the Upper Flathead Valley Area, there are soils in all three of the soil orders—zonal, intrazonal, and azonal.

Zonal soils are defined as having well-developed characteristics that reflect the influence of the active factors of soil genesis—climate and living organisms, chiefly vegetation. The zonal soils of the Area are in the Brown Podzolic, Gray Wooded, Chernozem, and Chestnut great soil groups.

Intrazonal soils have more or less well-developed soil characteristics that reflect the dominating influence of some local factor of relief, parent material, or age over the normal effects of climate and vegetation. In the Upper Flathead Valley Area the intrazonal soils belong to the Low-Humic Gley, Bog, and Solonetz great soil groups.

Azonal soils are without well-developed profile characteristics because their youth, parent material, or relief has prevented the development of definite profile characteristics. The azonal soils in this Area belong to the Regosol and Alluvial great soil groups. Soils of the Lithosol great soil group are also fairly widespread in steeper glaciated areas where the till is very thin or lacking, but these soils were mapped in the miscellaneous land type, Mountainous land.

Table 11 lists the soil series of the Upper Flathead Valley Area by orders and great soil groups and gives some of the factors that have influenced their formation.

TABLE 11.—*The soil series of the Upper Flathead Valley Area classified by higher categories and some of the factors that have contributed to the morphology of the soils*

ZONAL

Great soil group and soil series	Parent material	Relief	Drainage	Native vegetation
Brown Podzolic:				
Krause	Moderately coarse textured alluvium and outwash.	Nearly level to steep	Excessive	Coniferous forest.
McCaffery	Moderately coarse textured alluvium and outwash.	Nearly level to steep	Excessive	Coniferous forest.
Selle	Moderately coarse textured outwash and terrace deposits.	Nearly level to gently sloping	Excessive	Coniferous forest.
Waits	Moderately coarse textured glacial till.	Nearly level to steep	Good [1]	Coniferous forest.
Gray Wooded:				
Depew	Moderately fine textured alluvium.	Nearly level to gently sloping	Moderately good.	Coniferous forest.
Half Moon	Medium-textured alluvium and lake sediment.	Nearly level to gently sloping	Good	Coniferous forest.
Haskill	Moderately coarse textured outwash, wind modified.	Nearly level to steep	Good	Coniferous forest.
Stryker	Medium-textured alluvium	Nearly level to very gently sloping.	Imperfect	Coniferous and deciduous forest.
Swims	Medium-textured alluvium	Nearly level to gently sloping	Moderately good.	Coniferous and deciduous forest.
Walters	Medium and moderately coarse textured alluvium.	Nearly level to gently sloping	Good	Coniferous and deciduous forest.
Whitefish	Medium-textured glacial till	Nearly level to very steep	Good	Coniferous forest.
Chernozem:				
Creston	Medium-textured old alluvium	Level to steep	Good	Grasses.
Flathead	Moderately coarse textured alluvium.	Nearly level to sloping	Good	Grasses.
Mires	Medium-textured glacial outwash.	Nearly level to steep	Somewhat excessive.	Grasses.
Yeoman	Medium-textured glacial till	Nearly level to very steep	Good	Grasses.
Chestnut:				
Kalispell	Medium-textured alluvium and outwash.	Nearly level to very steep	Good	Grasses.
Prospect	Medium-textured glacial till	Nearly level to very steep	Good	Grasses.
Somers	Fine- to medium-textured alluvium.	Nearly level to gently sloping	Moderately good.	Grasses.
Tally	Moderately coarse textured alluvium and outwash.	Nearly level to sloping	Excessive	Grasses.

[1] "Good" is equivalent to "well drained."

TABLE 11.—*The soil series of the Upper Flathead Valley Area classified by higher categories and some of the factors that have contributed to the morphology of the soils*—Continued

INTRAZONAL

Great soil group and soil series	Parent material	Relief	Drainage	Native vegetation
Low-Humic Gley:				
Radnor	Moderately fine textured alluvium.	Level to very gently sloping	Poor	Grasses.
Bog:				
Muck and Peat	Vegetative residue and some alluvium.	Depressed areas	Poor	Grasses and sedges.
Solonetz:				
Demers	Medium-textured alluvium	Level to steep	Poor	Grasses.
Tuffit	Moderately fine textured alluvium.	Nearly level to gently sloping	Imperfect	Grasses.

AZONAL

Great soil group and soil series	Parent material	Relief	Drainage	Native vegetation
Regosol:				
Birch	Moderately coarse textured recent alluvium.	Level to gently sloping	Excessive	Coniferous and deciduous forest and grasses.
Blanchard	Moderately coarse textured alluvium, wind reworked.	Nearly level to very steep	Excessive	Coniferous forest and grasses.
Kiwanis	Medium and moderately coarse textured alluvium.	Nearly level to gently sloping	Good	Grasses.
Alluvial:				
Banks	Moderately coarse textured alluvium.	Level to gently sloping	Good	Coniferous and deciduous forest and grasses.
Chamokane	Moderately coarse textured alluvium.	Nearly level to gently sloping	Good	Deciduous forest.
Corvallis	Medium to moderately fine textured alluvium.	Level to very gently sloping	Imperfect	Grasses.

Morphology of Soils

In this subsection the morphology of the soil series of the Upper Flathead Valley Area is discussed by soil orders and great soil groups. The soil series are discussed in approximately the same sequence as they are listed in table 11, which can be referred to for additional information on the factors that have influenced development of the soils.

Zonal soils

The zonal soils of the Upper Flathead Valley Area belong to the Brown Podzolic, Gray Wooded, Chernozem, and Chestnut great soil groups.

BROWN PODZOLIC SOILS

The Brown Podzolic soils of the Upper Flathead Valley Area have developed under dense, nearly pure stands of coniferous forest in which Douglas-fir is dominant. Other firs, spruce, larch, lodgepole pine, and white pine are minor species. Individual deciduous trees or small patches of deciduous trees occur on most of the soils at places where there is more than the normal amount of moisture. Lodgepole pine, though normally one of the minor species, invades all soils following fire or timber harvest. Before burning or harvest, lodgepole pine is more numerous on the coarser textured soils that have lower moisture supply. White pine tends to be more abundant in the moist sites.

The Brown Podzolic soils of this Area are in the Krause, McCaffery, Selle, and Waits series. All are well drained to excessively drained. In virgin areas they have A_{00} and A_0 horizons from 2 to 5 inches thick; very thin, or no, A_1 or A_2 horizons; and yellowish-brown to dark-brown B_2 horizons that grade gradually to C horizons. The soils vary considerably in texture and thickness, in depth to weathered material, in amount of free calcium carbonate that has been removed, and in amount and size of coarse fragments on the surface and in the profile.

GRAY WOODED SOILS

Gray Wooded soils have developed under dominantly coniferous forest that includes all the species mentioned for Brown Podzolic soils, and, in addition, ponderosa pine. In some areas ponderosa pine forms almost pure stands on the Gray Wooded soils. White pine also grows on these soils, but almost entirely on the imperfectly drained members and in small, moist places on the well-drained members.

The soils of the Gray Wooded group in this Area are the Depew, Half Moon, Haskill, Stryker, Swims, Walters, and Whitefish. The Whitefish soils, developed in till, and the Half Moon soils, developed in alluvium and lake sediments, are the well-drained, medium-textured members of the Gray Wooded great soil group. The Depew soils, moderately well drained for the most part, are the moderately fine textured associates of the Half Moon soils. As mapped in this area, however, the Depew soils include some well-drained areas near the streamward edges of the terraces. The Stryker soils, imperfectly or somewhat poorly drained, are of medium to moderately fine texture; they are associated with Half Moon and Depew soils.

The Haskill soils developed in eolian and outwash loamy fine sand and fine sand; they are unique among the Gray Wooded soils. They have a weakly defined A_2 horizon, 20 to 30 inches or more in thickness. The lower half of this layer, or more, contains nodular lumps of material like that in the B_2 horizon. The boundary between the A_2 and B_2 horizons is abrupt or clear. The B_2 horizon is marbled, pale-brown and brown loam or fine sandy loam, 2 to 6 inches thick. The B_2 rests abruptly on calcareous fine sand. The A_2 and B horizons are slightly acid to about neutral in reaction.

The Swims and Walters soils are weakly developed Gray Wooded soils forming in alluvium on low terraces or high bottoms along the Flathead River. Generally, they are above flood level. These soils are Gray Wooded soils intergrading to Alluvial soils.

CHERNOZEM SOILS

The Chernozem soils have developed under a cover of grass. In the Upper Flathead Valley Area, individual trees or small clumps of trees are scattered over the landscape occupied by the Chernozem soils. The main grasses are wheatgrass, bluegrass, needlegrass, niggerwool, and June grass.

Soils of the Chernozem group have deep, dark to nearly black surface horizons that are rich in organic matter. For the most part, they lack textural B horizons but have moderately developed color B horizons. Chernozems have layers in which calcium carbonate has accumulated.

The soils of the Chernozem group in this Area are the Creston, Flathead, Mires, and Yeoman. The Creston soils, which developed in medium-textured old alluvium on the nearly level terraces, represent most clearly the modal characteristics of Chernozem soils in this Area.

The Flathead soils developed in moderately coarse alluvium, and the Mires, in medium-textured glacial outwash. They are on fans and terraces. The Yeoman soils developed in medium-textured glacial till and are of small extent. They occur mainly in areas transitional from Chernozem to Gray Wooded soils. As mapped, the Yeoman soils contain areas of degraded Chernozems. Nearly all areas of the Yeoman soils once had individual scattered trees and thin stands of ponderosa pine, as well as a heavy cover of grass. The Yeoman soils are more deeply leached of lime carbonate and have a thicker solum than any of the other grassland soils except the moderately sandy Chernozems (Mires and Flathead series) and the sandy chernozemic Regosols (Blanchard) series.

CHESTNUT SOILS

The Chestnut soils have dark-brown surface horizons which are underlain by lighter colored horizons. They have accumulations of calcium carbonate in their profile. Chestnut soils developed under a cover of grasses similar to that of the Chernozem soils, but they formed under drier conditions.

The Chestnut soils of this Area are the Kalispell, Prospect, Somers, and Tally. The Kalispell and Prospect soils best represent this great soil group. The Kalispell soils developed in medium-textured old alluvium on the terraces; the Prospect, from medium-textured till.

The Somers soils have moderately fine textured, moderately thick solum; their C_{ca} horizon overlies a moderately coarse to coarse substratum.

The Tally series is the Chestnut counterpart of the Mires and Flathead soils, both of which are Chernozems.

Intrazonal soils

The intrazonal soils of the Upper Flathead Valley Area are in the Low-Humic Gley, Bog, and Solonetz great soil groups.

LOW-HUMIC GLEY SOILS

Low-Humic Gley soils have a thin surface horizon, are poorly drained, and are moderately high in organic matter. The organic surface layer is underlain by mottled gray, gleylike mineral horizons. The major process of soil development is gleization. The Radnor is the only soil of the Upper Flathead Valley Area in the Low-Humic Gley great soil group.

Soil of the Radnor series has an organic surface layer 2 to 8 inches thick and a gray, clayey surface soil about 6 inches thick. The subsoil is gray, silty clay loam that is mottled and stained with brown and yellow. The subsoil is underlain by material that is white and variable in texture.

BOG SOILS

The Bog soils are represented by Muck and Peat in the Upper Flathead Valley Area. These are poorly drained soils that developed from an accumulation of plant remains. In areas flooded periodically by runoff, some mineral soil sediment has accumulated, and it may occur as bands between organic layers. The organic matter in areas mapped as Muck and Peat is in all stages of decomposition.

SOLONETZ SOILS

Solonetz soils have surface horizons of varying degrees of friability underlain by darker colored horizons, ordinarily with columnar structure. The layer with columnar structure is hard and normally highly alkaline. Solonetz soils developed under grass or shrubs, mostly in areas of low rainfall. Where the hard, clayey layer is overlain with a light-colored leached layer, the soils are called solodized-Solonetz.

The Solonetz and solodized-Solonetz soils of the Upper Flathead Valley Area were not mapped as separate units. They are included in a miscellaneous land type, Saline-alkali land, or are mapped in a complex with associated zonal soils. None of the soils formed in this Area under the solonization processes have been analyzed in the laboratory. The nature and kind of salts present and their range in alkalinity are not known.

The Solonetz soils (Tuffit series) and the solodized-Solonetz soils (Demers series) lack the sharply defined horizonation of soils in these great soil groups that occur on the Northern Great Plains. The Solonetz soils in the Upper Flathead Valley Area have very dark grayish-brown A_1 horizons, 3 to 6 inches thick, and dark grayish-brown, moderately dispersed, usually weakly calcareous B horizons. Their consistence is hard when dry and firm when moist, rather than very hard or extremely hard and very firm, as is typical of most Solonetz soils on the plains east of the Rocky Mountains. In addi-

tion, the Solonetz soils of this Area lack the soluble salts, other than calcium carbonate, that are usually present in the lower B and the C horizons of Solonetz soils on the plains. The reaction of the Solonetz soils of this Area is moderately to strongly alkaline by field test, or from pH 8 to 9.

The solodized-Solonetz soils of this Area have only thin or weakly developed A_2 horizons and mostly moderate to strong, prismatic and blocky B_2 horizons, rather than the strong and very strong, prismatic and columnar structure of comparable horizons in solodized-Solonetz soils on the plains.

Azonal soils

The azonal soils of the Upper Flathead Valley Area are in the Regosol and Alluvial great soil groups.

REGOSOLS

Regosols consist of deep unconsolidated material in which few, or no, clearly expressed soil characteristics have developed. They are represented in the Upper Flathead Valley Area by the Blanchard, Birch, and Kiwanis soils. The Blanchard soils are chernozemic Regosols developing in moderately coarse alluvium and outwash that was appreciably modified by wind before it was stabilized by vegetation. Blanchard soils have a fairly dark A_1 horizon, but it has been bleached, as in a degraded Chernozem, because of the encroachment of trees, mainly ponderosa pine.

The Birch and Kiwanis soils are developing in alluvium.

ALLUVIAL SOILS

Alluvial soils consist of transported and relatively recently deposited alluvium. The alluvium has been weakly modified by soil-forming processes. In this Area, the Banks, Chamokane, and Corvallis soils are Alluvial soils. They are nearly level or gently sloping soils on first bottoms along streams. They characteristically lack a soil profile with genetically related horizons. Their properties are closely related to the alluvial deposit. Some unclassified Alluvial soils are included with the miscellaneous land types correlated as Alluvial land, poorly drained, and Alluvial land, well drained.

Additional Facts About the Area

In this section the history and development of the Area, the community facilities, and the agriculture are described. The statistics on agriculture and population are from Federal census reports.

Settlement and Population

The Upper Flathead Valley Area was inhabited by the Flathead, and possibly the Kootenai, Indians before white men arrived. Fur traders and trappers entered the area in the middle of the nineteenth century. A Hudson's Bay Company fur-trading post was established in the 1840's, south of Flathead Lake. Prospectors followed the fur traders, and a few stockmen appeared in the 1880's.

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Demersville, about 2 miles south of the present town of Kalispell, was founded about 1887 on the banks of the Flathead River. Demersville was the point of entry for supplies brought from the south by steamboats that crossed Flathead Lake. There was a military post at Demersville for a short time, around 1890. Demersville was abandoned shortly after the Great Northern Railway was built through the Area in 1892.

Flathead County was created in 1893 from a part of Missoula County. Some of the original Flathead County was lost when Lincoln and Lake Counties were formed in 1909 and 1923, respectively. Flathead County now contains 5,177 square miles. The population was 31,495 in 1950, according to the United States Census.

Kalispell, the county seat, is the main trade center for Flathead County. In addition to the ordinary business establishments, it has fairly large flourmills and sawmills.

Whitefish is a trade center for the northern part of the Upper Flathead Valley Area and is a division point on the Great Northern Railway. Columbia Falls, Kila, and Ferndale are minor trade centers. Bigfork, on the northeastern corner of Flathead Lake, and Somers, on the northwestern corner, are small trade centers.

The towns of the Area have modern municipal improvements, and their educational facilities meet State standards. The hydroelectric plant on the Swan River at Bigfork furnishes power for most of the Area.

Transportation and Markets

The main line of the Great Northern Railway crosses the northern end of the area in an east-west direction, and a branch of this line connects Kalispell with the main line at Columbia Falls. The railway provides facilities for shipping livestock and crops to markets in Spokane and Seattle, Wash., in Great Falls, Mont., and in St. Paul, Minn. Motor freight lines carry produce in most directions, but chiefly south to Missoula. The main markets in Montana are Great Falls, Missoula, and Butte.

Several hard-surfaced State and Federal highways lead to all towns in the Area. County roads are generally of improved earth and gravel construction. Unimproved roads generally are passable because they are built on sandy soils.

Agriculture

The Flathead Indians, under the guidance of Father DeSmet, were the first farmers in the Upper Flathead Valley Area. The first white settlers were mainly stockmen. They harvested native grasses for hay but grew few crops.

The building of the railway in 1892 helped develop forest industries, which encouraged farming. Many of the early farmers were lumberjacks who bought small tracts of land and farmed part of the time. Some bought grassland; others purchased a small acreage of cutover land and cleared it. Many of the lumberjacks were forced into farming by mechanization in the lumber industry. During the drought of the 1930's, many families from States to the east moved to the cutover lands in this Area.

Farming the cutover lands has been difficult because holdings generally are small, and because clearing away the stumps is expensive. Use of bulldozers has reduced the cost of clearing and is bringing more land into agricultural production. Nevertheless, many of the farms are so small that the owners must seek part of their living from sources off the farm.

Crops

The crops grown in the Area have changed with changes in the lumbering industry. In the earlier days, oats and hay were important because many horses were used in lumbering. Mechanization of lumbering decreased the demand for oats, hay, and pasture. During World War I, wheat became a major crop. Recently, the trend has been toward dairying and poultry raising and growing of small fruits, but wheat is still the main crop, especially in the drier areas.

The acreages of principal crops, in 1954, are shown in the following list. These figures are for Flathead County, but they illustrate conditions in the Upper Flathead Valley Area, since most of the cropland in the county is in this area.

Crop:	*Acres in 1954*
Grains threshed or combined:	
Winter wheat	22,054
Spring wheat	11,223
Barley	13,365
Oats	8,077
Corn for all purposes	125
Hay harvested:	
Alfalfa	15,107
Clover or timothy	5,475
Small grains cut for hay	1,960
Wild hay cut	5,653
All other hay cut	2,421
Peas harvested for seed	1,647
Potatoes harvested for sale and home use	707
Vegetables harvested for sale	109
Berries harvested for sale	35
Land in bearing and nonbearing fruit orchards, vineyards, and planted nut trees	155

Wheat and barley are almost the only crops grown in the driest parts of the Area. In these areas the hay and pasture yield so little that they do not compete with wheat or barley. Winter wheat is preferred to spring wheat in the drier areas because it matures earlier and partly escapes the drought, insects, and diseases. Spring wheat is preferred where the soil is subirrigated or on drier sites that can be worked earlier in spring, as spring wheat tends to lodge less than winter wheat. The acreage of winter wheat was about double the acreage of spring wheat in 1954. The acreage of barley was less than half the total acreage of wheat.

Alfalfa and oats are grown on fairly large acreages, but the acreage of oats has declined steadily. Corn and rye are minor field crops. The cool growing season probably accounts for the small acreage of corn. The rye is grown mainly on the poorer soils.

Alfalfa is grown mainly on land irrigated from small wells or streams, or on the soils that have good natural capacity for holding water that plants can use. Other hay, mainly grass hay, is grown principally on the soils that are poorly drained, that are too steep or shallow for tillage, or that are in areas where there is more precipitation, as in the northern and eastern parts of the Area.

Potatoes are grown under irrigation, or in areas where there is more precipitation. The acreage is fairly constant because a few seed producers grow most of the crop and market registered seed potatoes.

Peas are grown under contract on the more productive soils, the Creston and Flathead for example, and the seed is marketed. The acreage varies according to the anticipated demand for seed peas. Yields range from 15 to 35 bushels per acre.

Small fruits and vegetables are produced in restricted localities. The needs of Kalispell and Whitefish are met by a few truck farmers, some of which use sprinkler irrigation.

A few specialized farms, mainly in the Echo Lake and Swan River communities, produce raspberries and strawberries for market. Some of the fruit is marketed in Great Falls, Butte, and Missoula. Cherries are a major crop just south of the Upper Flathead Valley Area, along the east side of Flathead Lake.

Livestock

Production of livestock in this Area is diversified. The number of livestock on farms in 1954 is shown in the following list:

Livestock of all ages:	*Number*
Horses and mules	1,799
Cattle	25,538
Milk cows	4,242
Hogs	5,923
Sheep	3,475
Chickens (more than 4 months old)	69,235

Nearly all the breeds of beef and dairy cattle are represented in the Area. Many farm herds are crosses of one or more beef and dairy breeds, but the number of purebred herds is increasing. Most of the milk is marketed as butterfat, but a few dairy farmers near Kalispell and Whitefish market fluid milk. The chickens on the farms are kept mainly for production of eggs.

Size and types of farms

The 1954 census reported 1,434 farms in Flathead County. The average farm contained about 300 acres. There were an estimated 656 miscellaneous and unclassified farms. The other farms were classified by type as follows:

	Estimated No. of farms
Cash grain	311
Livestock, other than dairy and poultry	187
Dairy	117
General farms	92
Poultry	45
Other field crop	16
Fruit and nut	10

About 45 percent of the farms contain less than 100 acres. These farms are operated mainly by part-time farmers who supplement their income through other types of employment.

Farm power

Mechanization of farm work varies greatly because of the range in agricultural activity. Only about 58 per-

cent of the farms are classified as commercial in the 1954 census. The rest are classed as residential or part-time farms. In 1954 the use of farm power was reported as follows:

	Number of farms
No tractor, horses, or mules	231
No tractor and only 1 horse or mule	35
No tractor and 2 or more horses or mules	94
Tractor and horses or mules	399
Tractor and no horses or mules	661

Most farms have electricity, telephones, piped running water, and automobiles and trucks.

Irrigation

According to the 1954 census, 206 farms in Flathead County had irrigation. Most of the water used is obtained from streams, wells, small lakes, or pits that are dug deep enough to reach the water table. Only the more nearly level soils that will produce good yields are irrigated.

One small, organized irrigation enterprise—the Ashley Irrigation Project—is in operation. It has been operating a number of years but is not satisfactory because the source of water, Ashley Lake, is not reliable. In some years the supply of water is limited and in other years there is no water.

GUIDE TO MAPPING UNITS AND CAPABILITY UNITS

Map symbol	Soil name	Described on page	Capability unit	Described on page
Aa	Alluvial land, poorly drained	29	Vw-1	16
Ab	Alluvial land, well drained	28	VIs-1	17
Ba	Banks loamy fine sand, 0 to 4 percent slopes	29	VIs-1	17
Bb	Banks very fine sandy loam, 0 to 4 percent slopes	29	VIs-1	17
Bc	Birch fine sandy loam, 0 to 5 percent slopes	30	IVs-1	15
Bd	Birch gravelly loam, 0 to 3 percent slopes	30	VIs-1	17
Be	Blanchard fine sand, 0 to 7 percent slopes	31	IVes-1	15
Bf	Blanchard fine sand, 0 to 7 percent slopes, wind eroded	31	IVes-1	15
Bg	Blanchard fine sand, 7 to 12 percent slopes	31	VIes-1	17
Bh	Blanchard fine sand, 7 to 12 percent slopes, wind eroded	31	VIes-1	17
Bk	Blanchard fine sand, 12 to 35 percent slopes	31	VIes-1	17
Bm	Blanchard fine sand, 12 to 35 percent slopes, wind eroded	31	VIes-1	17
Bn	Blanchard loamy fine sand, 0 to 3 percent slopes	31	IVes-1	15
Bo	Blanchard loamy fine sand, 3 to 7 percent slopes	31	IVes-1	15
Bp	Blanchard loamy fine sand, 7 to 20 percent slopes	32	VIes-1	17
Br	Blanchard loamy fine sand, 20 to 45 percent slopes	32	VIes-1	17
Bs	Blanchard very fine sandy loam, 0 to 7 percent slopes	32	IIes-1	12
Bt	Blanchard very fine sandy loam, 7 to 12 percent slopes	32	IVe-1	15
Bu	Blanchard very fine sandy loam, 12 to 20 percent slopes	32	VIe-1	16
Bv	Blanchard very fine sandy loam, 20 to 45 percent slopes	32	VIe-1	16
Ca	Chamokane soils, 0 to 3 percent slopes	33	IIe-2	12
Cb	Chamokane soils, 3 to 7 percent slopes	33	IIe-2	12
Cc	Chamokane and Banks soils, 0 to 4 percent slopes	33	IVs-1	15
Cd	Corvallis silty clay loam, 0 to 3 percent slopes	33	IIw-1	13
Ce	Creston silt loam, 0 to 3 percent slopes	34	I-1	11
Cf	Creston silt loam, 3 to 7 percent slopes	34	IIe-1	11
Cg	Creston silt loam, 7 to 12 percent slopes	34	IIIe-1	13
Ch	Creston silt loam, 12 to 45 percent slopes	34	VIe-1	16
Da	Demers-Kalispell silt loams, 0 to 3 percent slopes	35	VIs-2	17
Db	Demers-Kalispell silt loams, 3 to 7 percent slopes	35	VIs-2	17
Dc	Demers-Kalispell silt loams, 7 to 25 percent slopes	35	VIs-2	17
Dd	Depew silty clay, 0 to 3 percent slopes	36	IVs-2	15
De	Depew silty clay loam, 0 to 3 percent slopes	36	IIIs-3	14
Df	Depew silty clay loam, 3 to 7 percent slopes	36	IIIs-3	14
Fa	Flathead fine sandy loam, 0 to 3 percent slopes	36	IIes-1	12
Fb	Flathead fine sandy loam, 3 to 7 percent slopes	36	IIes-1	12
Fc	Flathead fine sandy loam, 7 to 20 percent slopes	36	IVe-1	15
Fd	Flathead sandy loam, 0 to 7 percent slopes	37	IIes-1	12
Fe	Flathead very fine sandy loam, 0 to 3 percent slopes	37	I-1	11
Ff	Flathead very fine sandy loam, 3 to 7 percent slopes	37	IIe-1	11
Fg	Flathead-Creston loams, 0 to 3 percent slopes	37	IIes-1	12
Fh	Flathead-Mires loams, 0 to 3 percent slopes	37	IIIs-1	13
Ha	Half Moon silt loam, 0 to 3 percent slopes	38	IIs-1	12
Hb	Half Moon silt loam, 3 to 8 percent slopes	38	IIIe-2	13
Hc	Half Moon very fine sandy loam, 0 to 3 percent slopes	38	IIs-1	12
Hd	Half Moon very fine sandy loam, 3 to 7 percent slopes	38	IIIe-2	13
He	Half Moon very fine sandy loam, 7 to 12 percent slopes	38	VIe-1	16
Hf	Half Moon soils, 12 to 45 percent slopes	38	VIe-1	16
Hg	Half Moon-Haskill complex, 0 to 3 percent slopes	39	IIIs-2	14
Hh	Half Moon-Haskill complex, 3 to 7 percent slopes	39	IIIs-2	14
Hk	Haskill fine sand, 0 to 7 percent slopes	39	IVs-3	16
Hm	Haskill fine sand, 7 to 12 percent slopes	39	VIes-1	17
Hn	Haskill fine sand, 12 to 45 percent slopes	39	VIes-1	17
Ho	Haskill loamy fine sand, 0 to 7 percent slopes	40	IVs-3	16
Hp	Haskill loamy fine sand, 7 to 20 percent slopes	40	VIes-1	17
Ka	Kalispell fine sandy loam, moderately deep over sand, 0 to 7 percent slopes	40	IIIs-1	13

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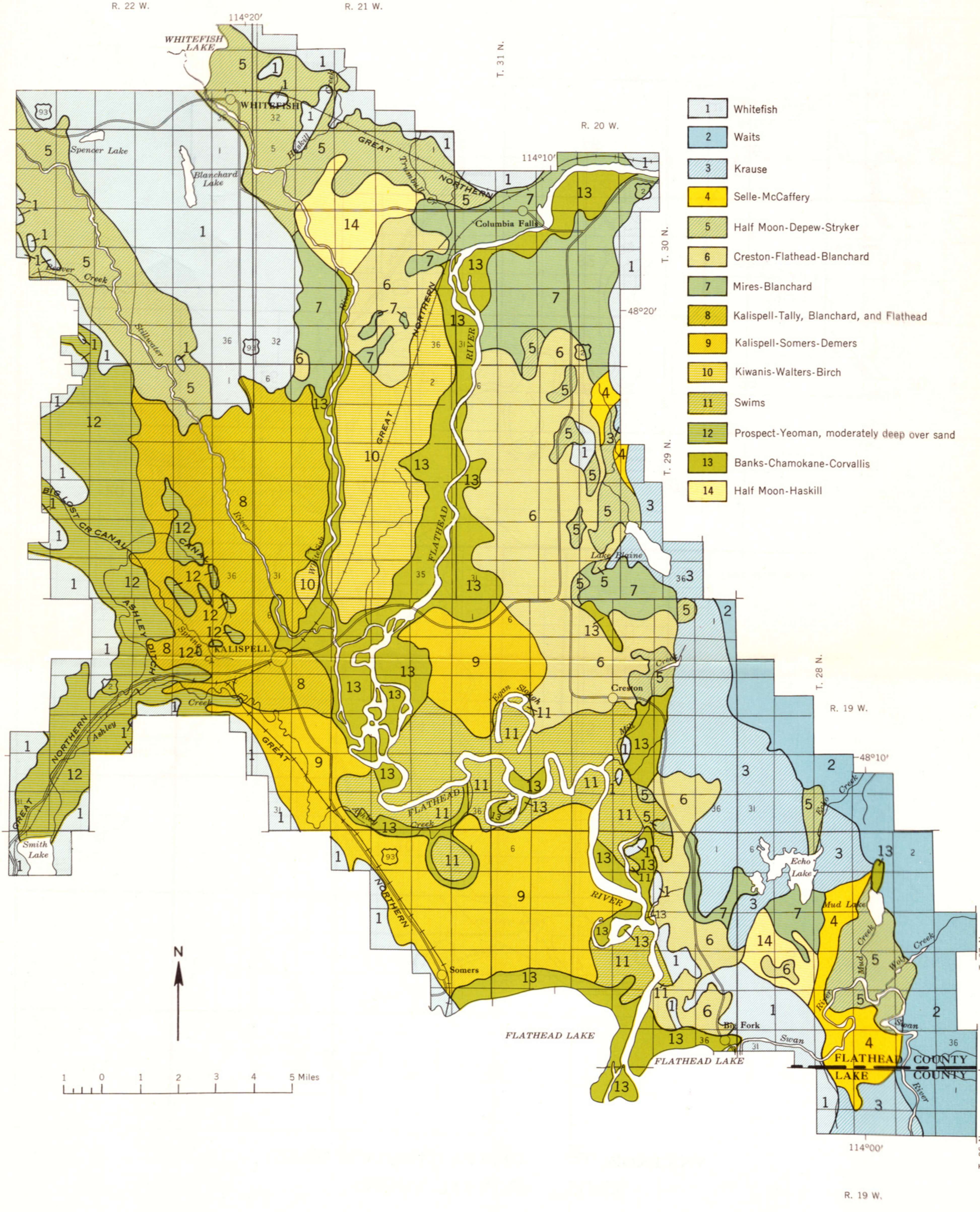
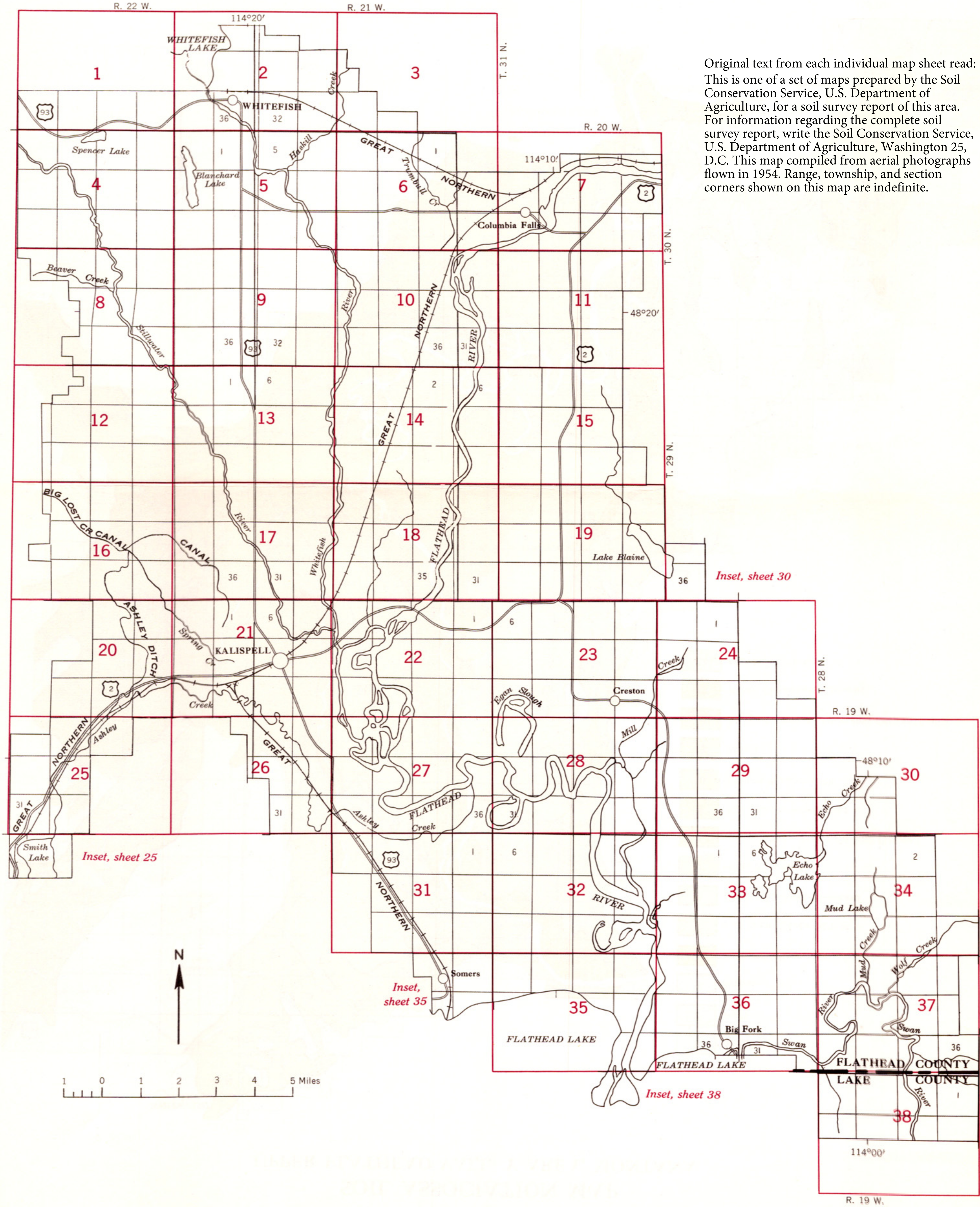
SOIL ASSOCIATION MAP
UPPER FLATHEAD VALLEY AREA, MONTANA



INDEX TO MAP SHEETS

UPPER FLATHEAD VALLEY AREA, MONTANA

Original text from each individual map sheet read:
This is one of a set of maps prepared by the Soil Conservation Service, U.S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U.S. Department of Agriculture, Washington 25, D.C. This map compiled from aerial photographs flown in 1954. Range, township, and section corners shown on this map are indefinite.



SOILS LEGEND

SYMBOL	NAME
Aa	Alluvial land, poorly drained
Ab	Alluvial land, well drained
Ba	Banks loamy fine sand, 0-4 percent slopes
Bb	Banks very fine sandy loam, 0-4 percent slopes
Bc	Birch fine sandy loam, 0-5 percent slopes
Bd	Birch gravelly loam, 0-3 percent slopes
	Blanchard fine sand:
Be	0-7 percent slopes
Bf	0-7 percent slopes, wind eroded
Bg	7-12 percent slopes
Bh	7-12 percent slopes, wind eroded
Bk	12-35 percent slopes
Bm	12-35 percent slopes, wind eroded
	Blanchard loamy fine sand:
Bn	0-3 percent slopes
Bo	3-7 percent slopes
Bp	7-20 percent slopes
Br	20-45 percent slopes
	Blanchard very fine sandy loam:
Bs	0-7 percent slopes
Bt	7-12 percent slopes
Bu	12-20 percent slopes
Bv	20-45 percent slopes
	Chamokane soils:
Ca	0-3 percent slopes
Cb	3-7 percent slopes
Cc	Chamokane and Banks soils, 0-4 percent slopes
Cd	Corvallis silty clay loam, 0-3 percent slopes
	Creston silt loam:
Ce	0-3 percent slopes
Cf	3-7 percent slopes
Cg	7-12 percent slopes
Ch	12-45 percent slopes
	Demers-Kalispell silt loams:
Da	0-3 percent slopes
Db	3-7 percent slopes
Dc	7-25 percent slopes
Dd	Depew silty clay, 0-3 percent slopes
	Depew silty clay loam:
De	0-3 percent slopes
Df	3-7 percent slopes
	Flathead fine sandy loam:
Fa	0-3 percent slopes
Fb	3-7 percent slopes
Fc	7-20 percent slopes
Fd	Flathead sandy loam, 0-7 percent slopes
	Flathead very fine sandy loam:
Fe	0-3 percent slopes
Ff	3-7 percent slopes
Fg	Flathead-Creston loams, 0-3 percent slopes
Fh	Flathead-Mires loams, 0-3 percent slopes
	Half Moon silt loam:
Ha	0-3 percent slopes
Hb	3-8 percent slopes
	Half Moon very fine sandy loam:
Hc	0-3 percent slopes
Hd	3-7 percent slopes
He	7-12 percent slopes
Hf	Half Moon soils, 12-45 percent slopes

SYMBOL	NAME
	Half Moon-Haskill complex:
Hg	0-3 percent slopes
Hh	3-7 percent slopes
	Haskill fine sand:
Hk	0-7 percent slopes
Hm	7-12 percent slopes
Hn	12-45 percent slopes
	Haskill loamy fine sand:
Ho	0-7 percent slopes
Hp	7-20 percent slopes
Ka	Kalispell fine sandy loam, moderately deep over sand, 0-7 percent slopes
	Kalispell gravelly loam, moderately deep over gravel:
Kb	3-7 percent slopes
Kc	7-12 percent slopes
Kd	12-40 percent slopes
	Kalispell loam:
Ke	0-3 percent slopes
Kf	0-3 percent slopes, wind eroded
Kg	3-7 percent slopes
Kh	3-7 percent slopes, wind eroded
Kk	7-12 percent slopes
Km	12-25 percent slopes
	Kalispell loam, moderately deep over gravel:
Kn	0-7 percent slopes
Ko	7-12 percent slopes
	Kalispell loam, moderately deep over sand:
Kp	0-3 percent slopes
Kr	3-7 percent slopes
Ks	7-12 percent slopes
Kt	12-40 percent slopes
Ku	Kalispell silt loam, heavy subsoil, 0-3 percent slopes
Kv	Kalispell silt loam, moderately deep over sand, 0-7 percent slopes
	Kalispell-Demers silt loams:
Kw	0-3 percent slopes
Kx	3-12 percent slopes
	Kalispell-Tuffit silt loams:
Kza	0-3 percent slopes
Kzb	3-7 percent slopes
Kzc	7-20 percent slopes
Kzd	Kiwanis fine sandy loam, 0-4 percent slopes
	Kiwanis loam:
Kze	0-3 percent slopes
Kzf	3-9 percent slopes
Kzg	Kiwanis-Birch fine sandy loams, 0-5 percent slopes
Kzh	Kiwanis-Birch loams, 0-4 percent slopes
	Krause gravelly loam:
Kzk	0-3 percent slopes
Kzm	3-7 percent slopes
Kzn	7-12 percent slopes
Kzo	12-35 percent slopes
Ma	Made land
Mb	McCaffery coarse sand, 0-5 percent slopes
	McCaffery loamy fine sand:
Mc	0-3 percent slopes
Md	3-7 percent slopes
Me	7-12 percent slopes
Mf	12-30 percent slopes

SYMBOL	NAME
	Mires gravelly loam:
Mg	0-3 percent slopes
Mh	3-7 percent slopes
Mk	7-12 percent slopes
Mm	12-30 percent slopes
	Mires loam:
Mn	0-3 percent slopes
Mo	3-7 percent slopes
Mp	7-12 percent slopes
Mr	Mountainous land
Ms	Muck and Peat
	Prospect loam:
Pa	0-3 percent slopes
Pb	3-7 percent slopes
Pc	7-12 percent slopes
Pd	12-20 percent slopes
	Prospect stony loam:
Pe	3-7 percent slopes
Pf	7-12 percent slopes
Pg	12-20 percent slopes
Ph	20-45 percent slopes
	Prospect-Tuffit silt loams:
Pk	0-3 percent slopes
Pm	3-7 percent slopes
Pn	7-20 percent slopes
Ra	Radnor silt loam, 0-3 percent slopes
Rb	Radnor silty clay loam, 0-3 percent slopes
Rc	Riverwash
Sa	Saline-alkali land
	Selle fine sandy loam:
Sb	0-3 percent slopes
Sc	3-8 percent slopes
	Somers silt loam:
Sd	0-3 percent slopes
Se	3-7 percent slopes
Sf	Somers silty clay, 0-4 percent slopes
	Somers silty clay loam:
Sg	0-3 percent slopes
Sh	3-8 percent slopes
Sk	Stryker silt loam, 0-3 percent slopes
Sm	Stryker silt loam, sandy subsoil, 0-3 percent slopes
Sn	Stryker silty clay loam, 0-3 percent slopes
	Swims silt loam:
So	0-3 percent slopes
Sp	3-7 percent slopes
Sr	Swims silty clay loam, 0-4 percent slopes
	Tally, Blanchard, and Flathead soils:
Ta	0-3 percent slopes
Tb	0-3 percent slopes, wind eroded
Tc	3-7 percent slopes
Td	3-7 percent slopes, wind eroded
Te	7-12 percent slopes
Tf	7-12 percent slopes, wind eroded
Tg	12-20 percent slopes
Th	Tuffit-Somers silty clay loams, 0-5 percent slopes
	Waits cobbly silt loam, fans:
Wa	0-3 percent slopes
Wb	3-7 percent slopes
Wc	Waits silt loam, 0-7 percent slopes
Wd	Waits silt loam, fans, 0-4 percent slopes

SYMBOL	NAME
	Waits stony silt loam:
We	0-7 percent slopes
Wf	7-12 percent slopes
Wg	12-35 percent slopes
Wh	Waits stony silt loam, fans, 0-7 percent slopes
	Waits and Krause stony loams:
Wk	0-7 percent slopes
Wm	7-12 percent slopes
Wn	12-40 percent slopes
Wo	Walters silt loam, 0-4 percent slopes
Wp	Walters very fine sandy loam, 0-7 percent slopes
	Whitefish cobbly silt loam:
Wr	0-7 percent slopes
Ws	7-12 percent slopes
Wt	12-20 percent slopes
Wu	20-45 percent slopes
	Whitefish gravelly silt loam:
Wv	0-7 percent slopes
Ww	7-12 percent slopes
Wx	12-25 percent slopes
	Whitefish silt loam:
Wza	0-3 percent slopes
Wzb	3-7 percent slopes
Wzc	7-12 percent slopes
Wzd	12-35 percent slopes
	Whitefish stony silt loam:
Wze	0-7 percent slopes
Wzf	7-12 percent slopes
Wzg	12-20 percent slopes
Wzh	20-45 percent slopes
	Yeoman cobbly loam, moderately deep over sand:
Ya	0-3 percent slopes
Yb	3-7 percent slopes
Yc	7-12 percent slopes
Yd	12-25 percent slopes
	Yeoman gravelly loam:
Ye	0-7 percent slopes
Yf	7-12 percent slopes
Yg	12-30 percent slopes
	Yeoman gravelly loam, moderately deep over sand:
Yh	0-3 percent slopes
Yk	3-7 percent slopes
Ym	7-12 percent slopes
Yn	12-20 percent slopes
Yo	20-40 percent slopes
	Yeoman loam, moderately deep over sand:
Yp	0-3 percent slopes
Yr	3-7 percent slopes
Ys	7-12 percent slopes
	Yeoman silt loam:
Yt	0-7 percent slopes
Yu	7-12 percent slopes
Yv	12-20 percent slopes
	Yeoman stony loam:
Yw	0-7 percent slopes
Yx	7-12 percent slopes
Yy	12-35 percent slopes
	Yeoman stony loam, moderately deep over sand:
Yza	0-7 percent slopes
Yzb	7-20 percent slopes
Yzc	20-35 percent slopes

Soils surveyed 1940-46 by Frederick K. Nunns, Montana Agricultural Experiment Station, and Verne Lupton and Russell Bodly, U. S. Department of Agriculture. Correlation by B. H. Williams, Soil Conservation Service.

Soil map constructed 1958 by Cartographic Division, Soil Conservation Service, USDA, from 1954 aerial photographs. Controlled mosaic based on Montana plane coordinate system, north zone, Lambert conformal conic projection, 1927 North American datum.

UPPER FLATHEAD VALLEY AREA, MONTANA

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

- Roads
  - Good motor
  - Poor motor
  - Trail
  - Marker, U. S. — 33
- Railroads
  - Single track
  - Multiple track
  - Abandoned
- Bridges and crossings
  - Road
  - Trail, foot
  - Railroad
  - Ferry
  - Ford
  - Grade
  - R. R. over
  - R. R. under
  - Tunnel
- Buildings
  - School
  - Church
  - Station
- Mine and Quarry
  - Shaft
  - Dump
  - Prospect
- Pits, gravel or other
- Power line
- Pipeline
- Cemetery
- Dam
- Levee
- Tank
- Oil well
- Windmill
- Canal lock (point upstream)

BOUNDARIES

- National or state
- County
- Township, civil
- Township, U. S.
- Section line, corner
- City (corporate)
- Reservation
- Land grant

DRAINAGE

- Streams
  - Perennial
  - Intermittent, unclass.
    - Crossable with tillage implements
    - Not crossable with tillage implements
- Canals and ditches — CANAL / DITCH
- Lakes and ponds
  - Perennial
  - Intermittent
- Wells — flowing
- Springs
- Marsh
- Wet spot

RELIEF

- Escarpments
  - Bedrock
  - Other
- Prominent peaks
- Depressions — Large / Small

SOIL SURVEY DATA

- Soil type outline and symbol — Dx
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Erosion
  - Uneroded spot — U
  - Sheet, moderate — S
  - Sheet, severe — SS
  - Gully, moderate — G
  - Gully, severe — GG
  - Sheet and gully, moderate — SG
  - Wind, moderate
  - Wind, severe
  - Blowout
  - Wind hummock
  - Overblown soil
- Gullies
- Areas of alkali and salts
  - Strong — A
  - Moderate — M
  - Slight — S
  - Free of toxic effect — F
- Sample location — 26
- Saline spot

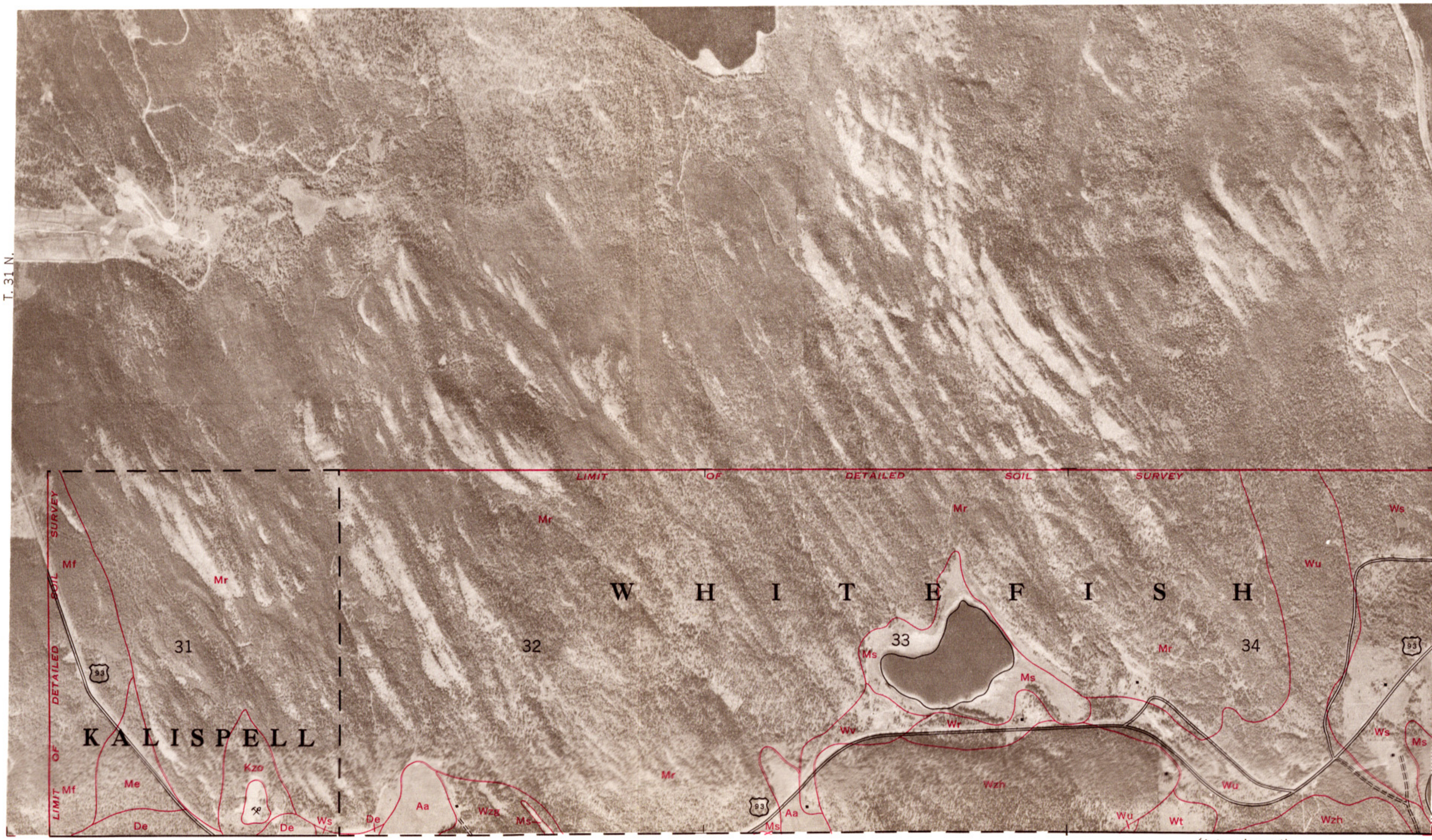
UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 1

R. 22 W.

1

N

T. 31 N.



(Joins sheet 2)

(Joins sheet 4)

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet


2
R. 22 W.
R. 21 W.
N
WHITEFISH LAKE
WHITEFISH
Whitefish
WHITEFISH RIVER
GREAT NORTHERN
Haskill Creek
GOLF COURSE
LIMIT OF DETAILED SOIL SURVEY
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 5)
T. 31 N.
24
19
20
25
30
29
28
35
36
31
32
33
93
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

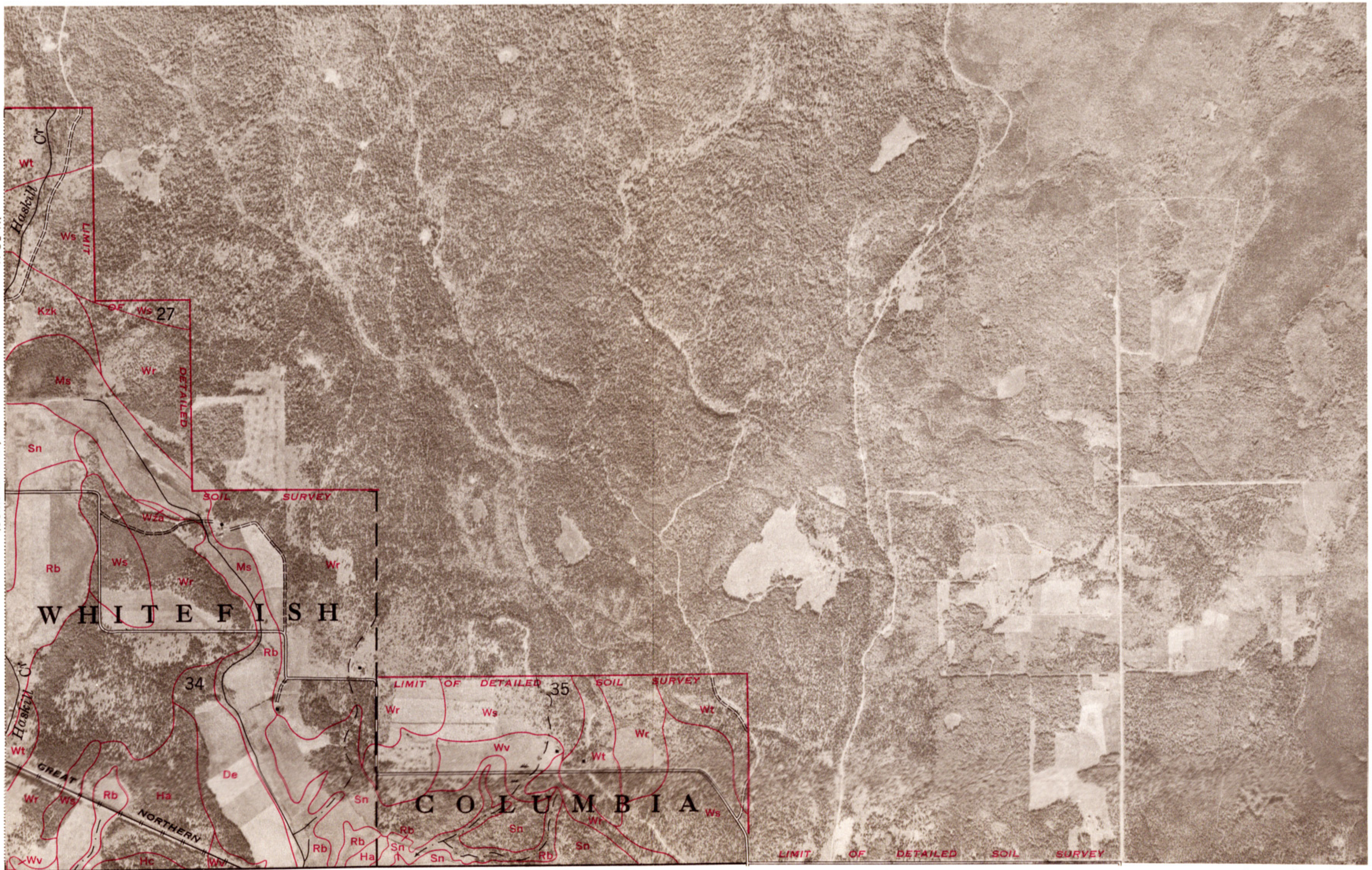
R. 21 W.

3

N

T. 31 N.

(Joins sheet 2)



(Joins sheet 6)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

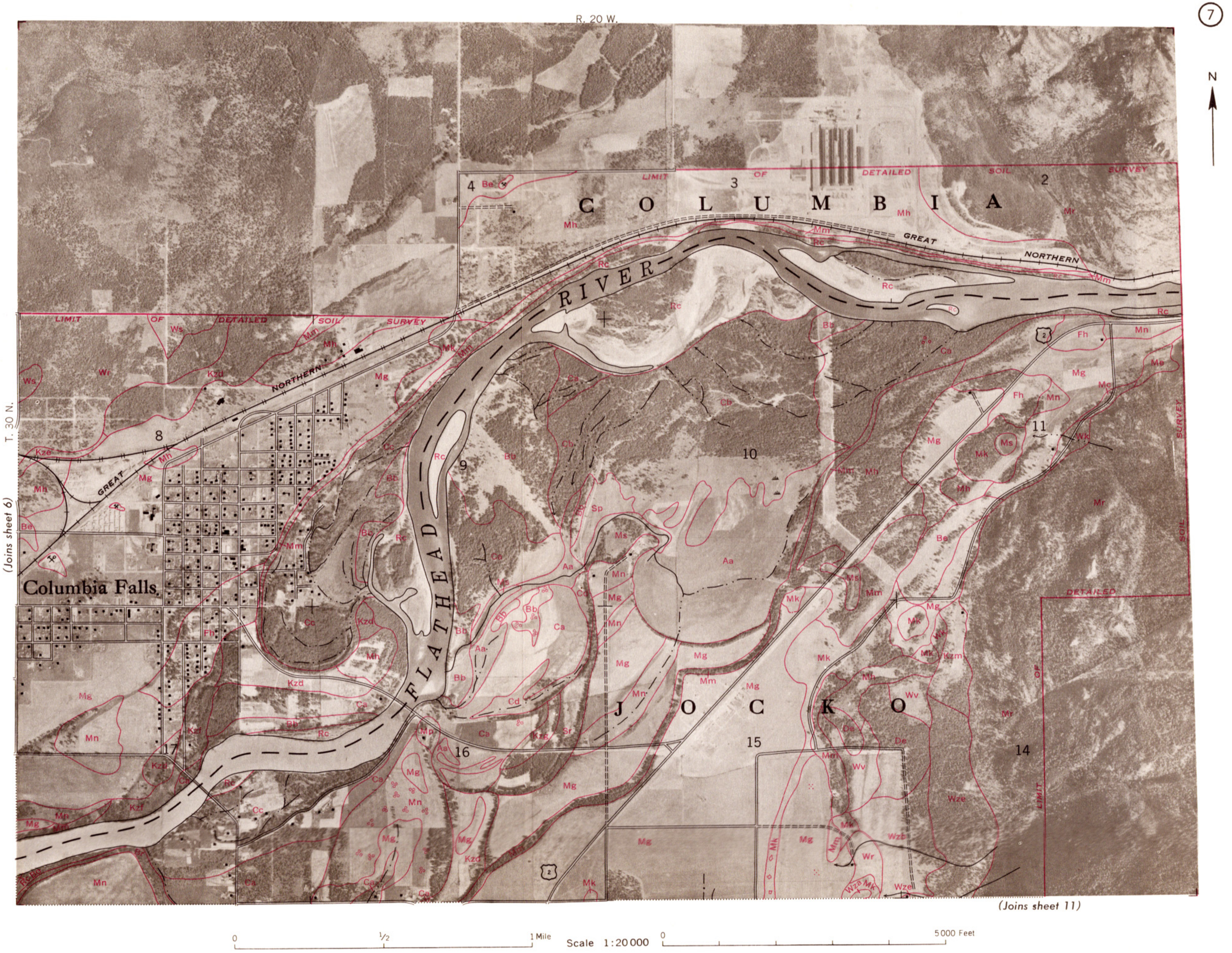
UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 5

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

Scale 1:20000

0 1/2 1 Mile

0 5000 Feet


R. 20 W.
T. 30 N.
N
(Joins sheet 6)
(Joins sheet 11)
COLUMBIA
GREAT NORTHERN
RIVER
FLATHEAD
JOCKO
Columbia Falls
LIMIT OF DETAILED SOIL SURVEY
0 ½ 1 Mile
Scale 1:20000
0 5000 Feet

8

(Joins sheet 4)

R. 22 W.

(Joins sheet 12)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet


10
(Joins sheet 6)
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 14)
R. 21 W. | R. 20 W.
T. 30 N.
N
C O L U M B I A
J O C K O
K A L I S P E L L
FLATHEAD
RIVER
WHITEFISH
RIVER
GREAT
NORTHERN
Half Moon
School
LaSalle
AIRFIELD
22
23
24
19
27
26
25
30
34
35
36
31
Scale 1:20 000
0
1/2
1 Mile
0
5000 Feet

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

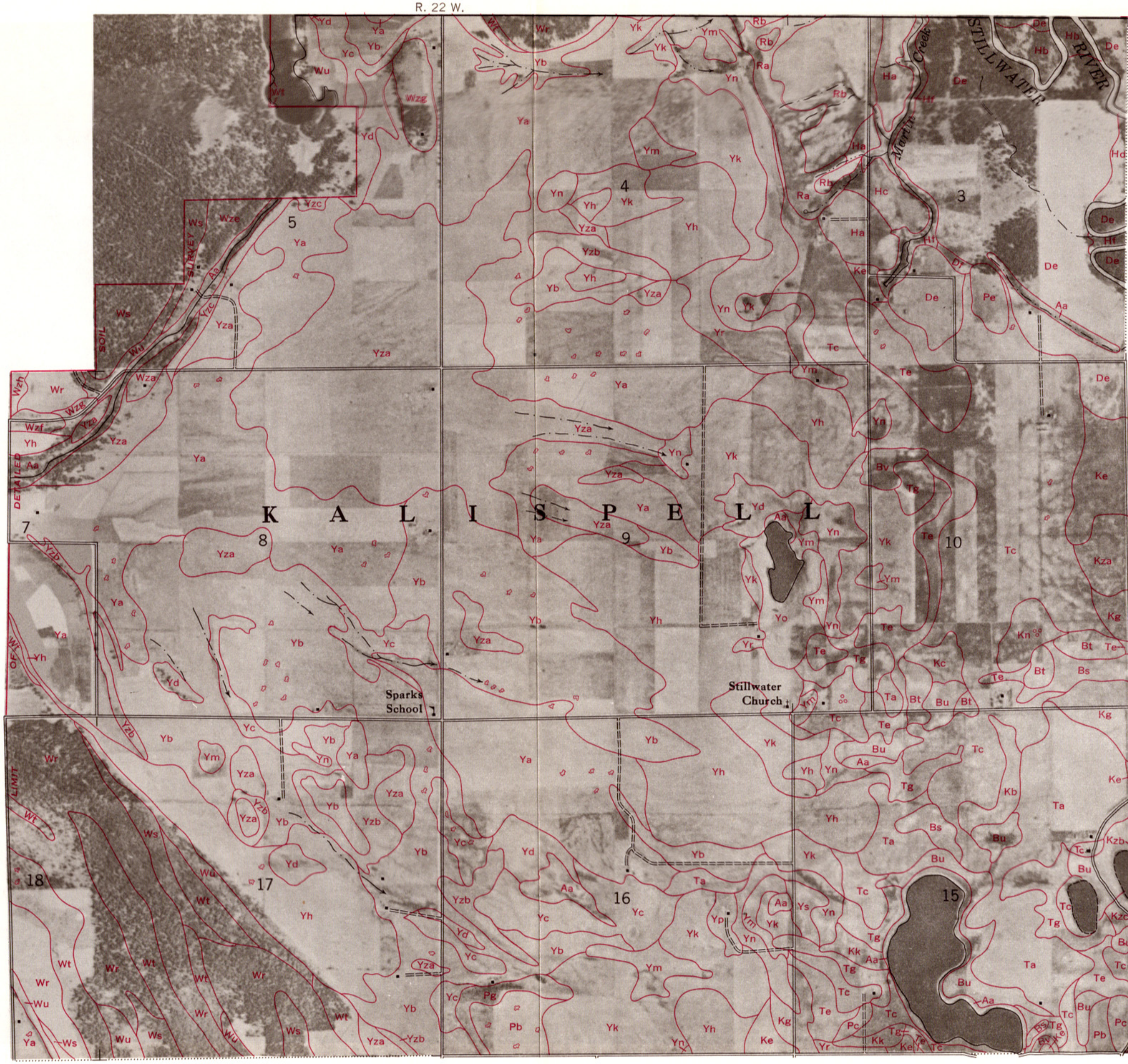
UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 12

12

(Joins sheet 8)

R. 22 W.

N



T. 29 N.

(Joins sheet 13)

(Joins sheet 16)

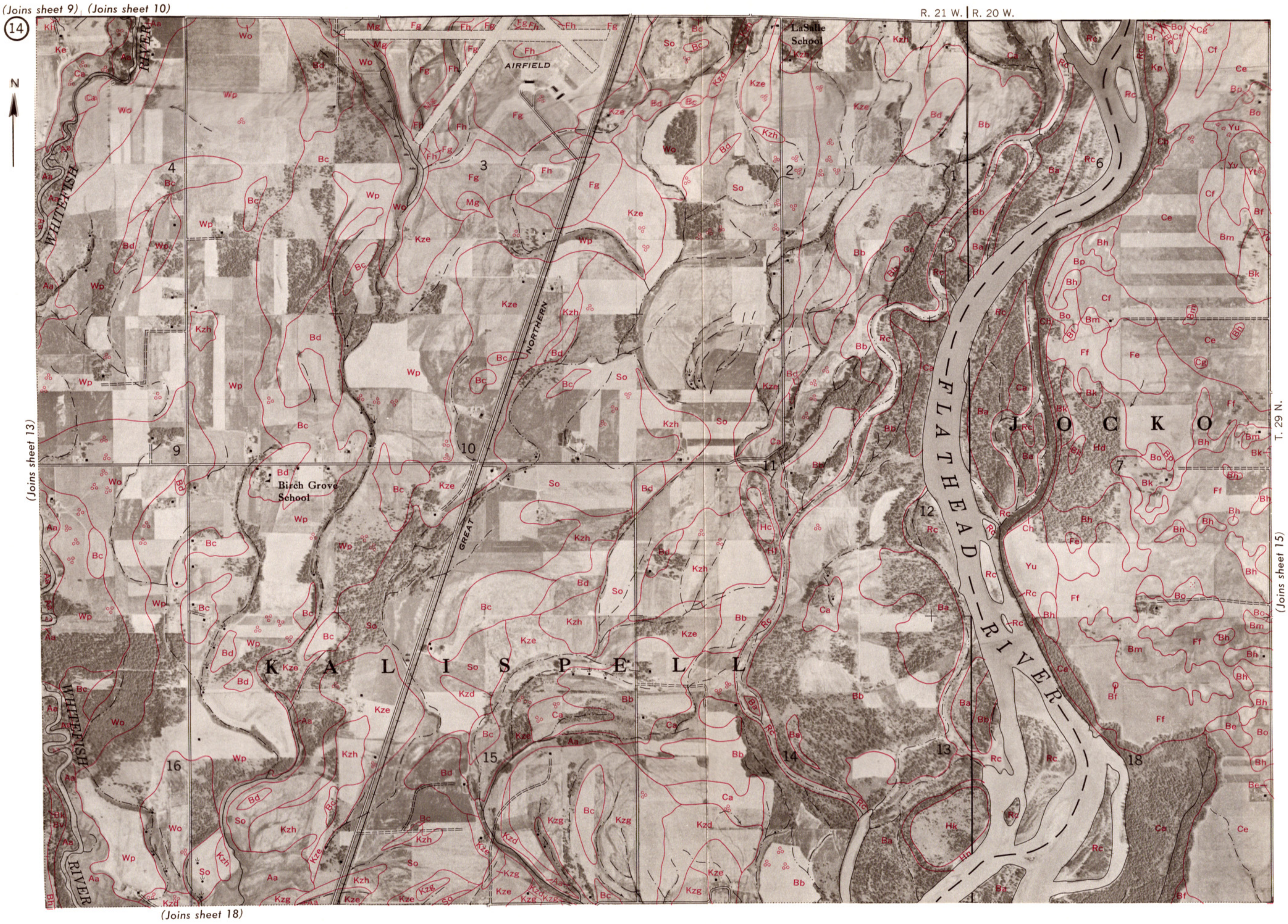
0 1/2 1 Mile Scale 1:20000 0 5000 Feet

R. 22 W. | R. 21 W.

(Joins sheet 9)

13

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



Scale 1:20 000

0 1/2 1 Mile

0 5000 Feet

(Joins sheet 11)

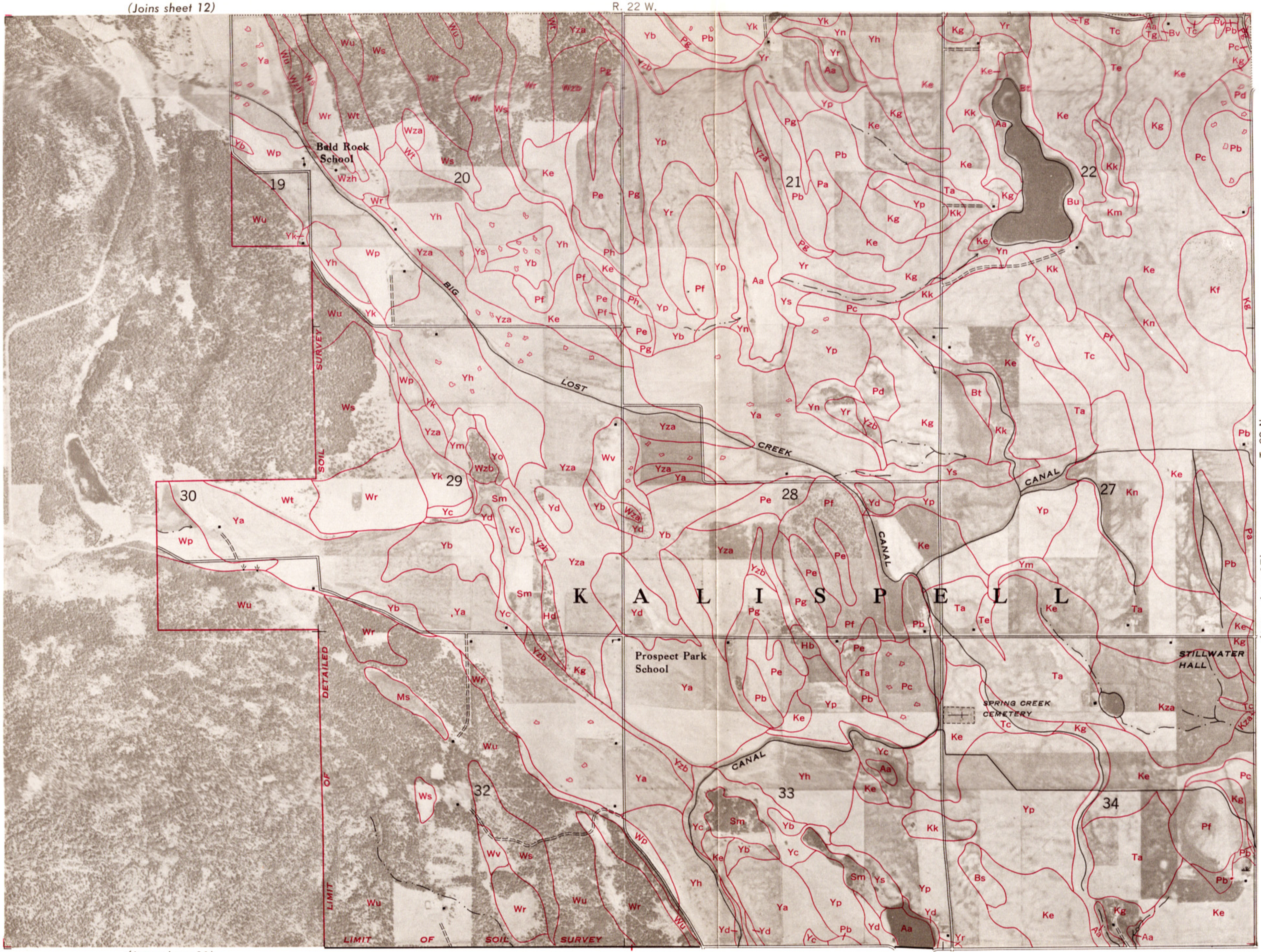
(Joins sheet 19)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

16

(Joins sheet 12)

R. 22 W.



(Joins sheet 17)

(Joins sheet 20)

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

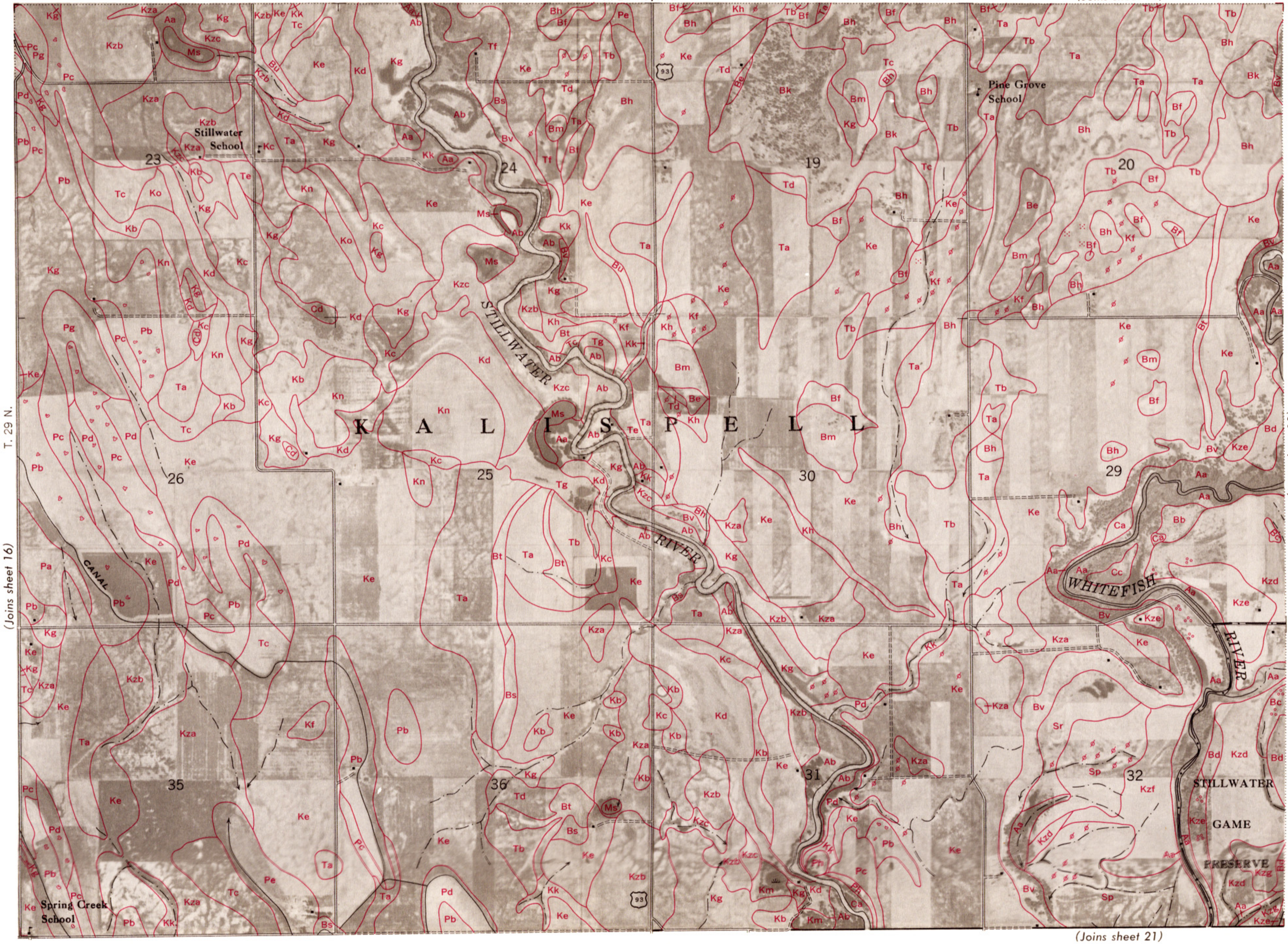
UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 17

R. 22 W. | R. 21 W.

(Joins sheet 13)

17

N



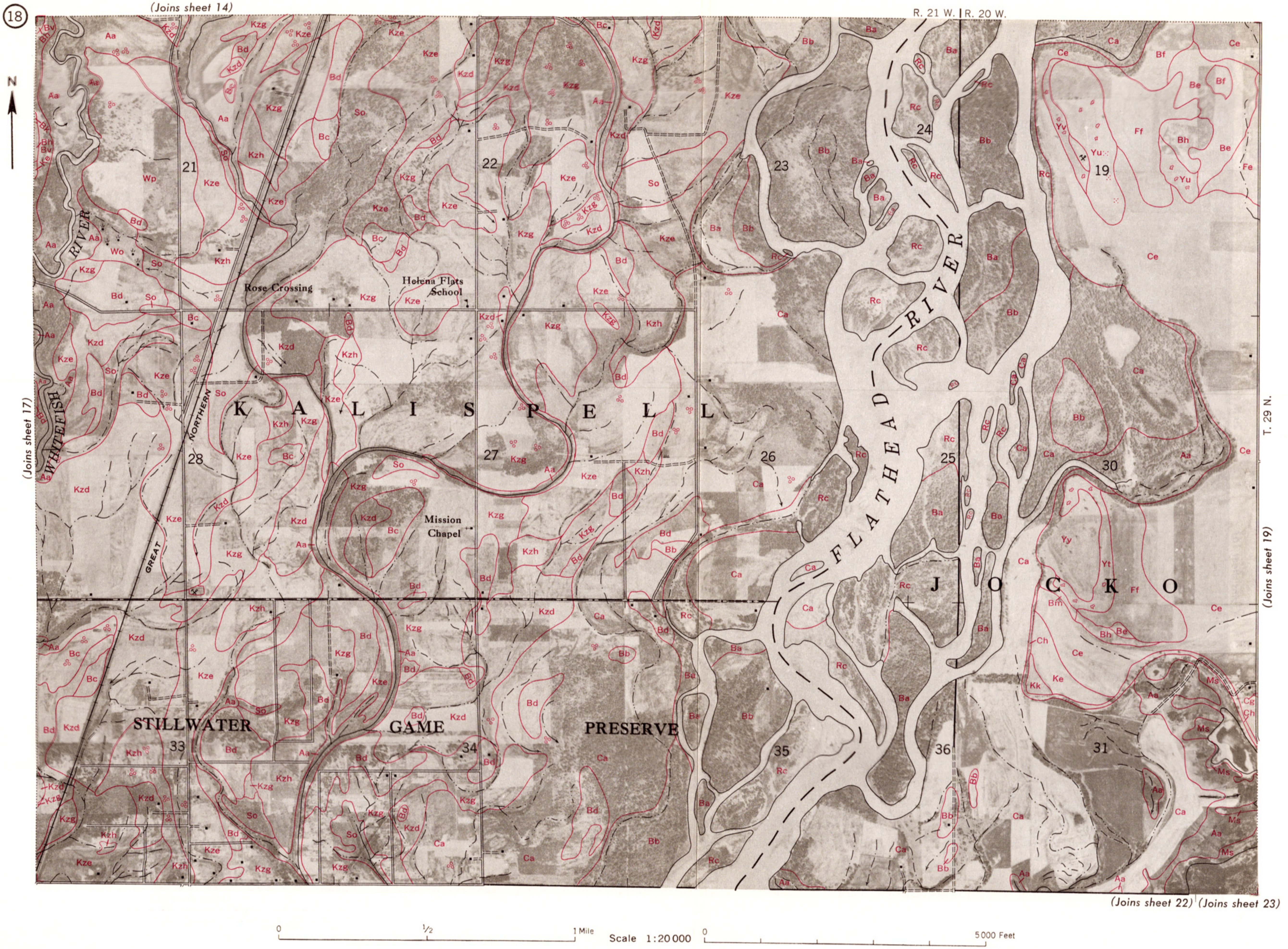
T. 29 N.

(Joins sheet 16)

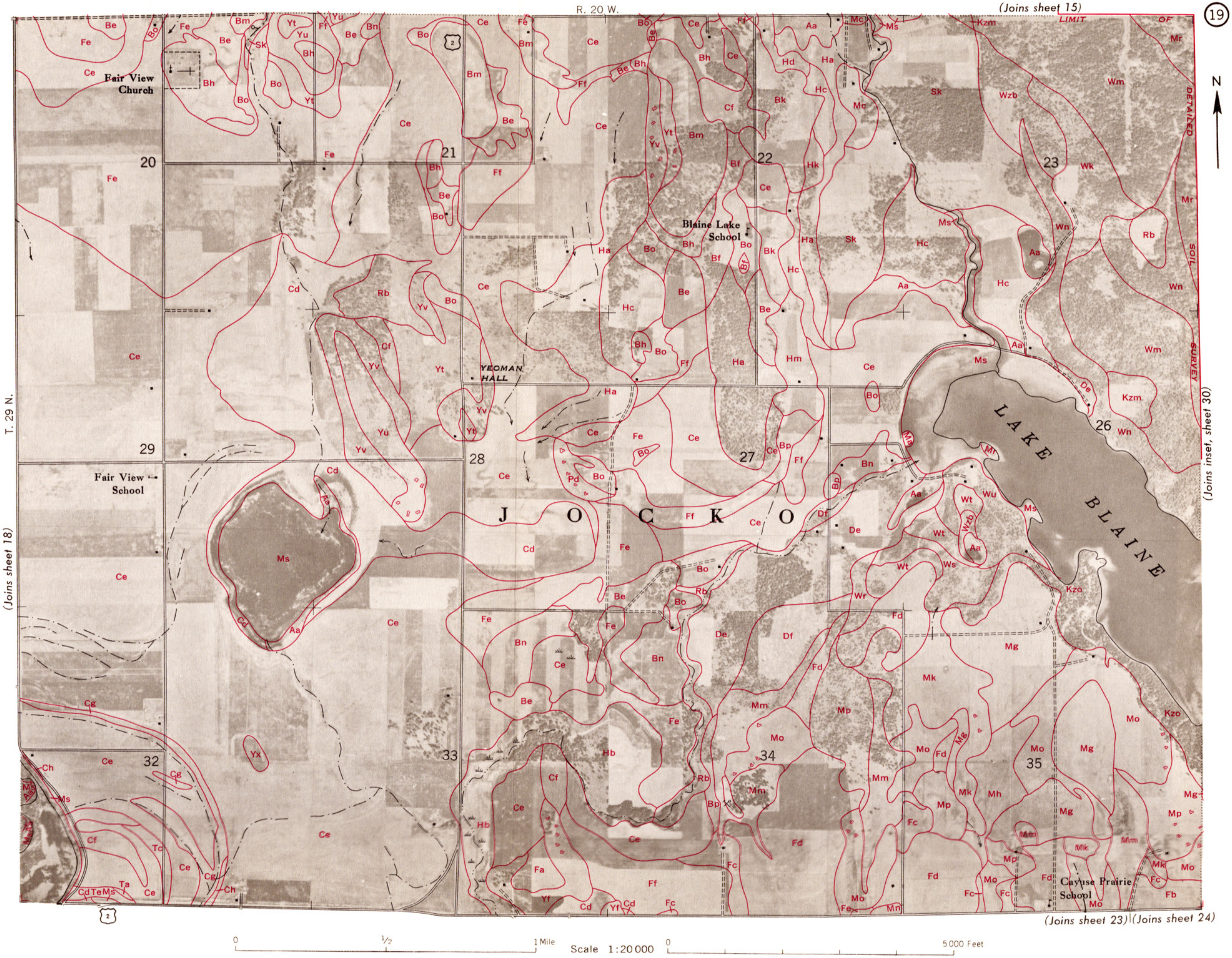
(Joins sheet 18)

(Joins sheet 21)

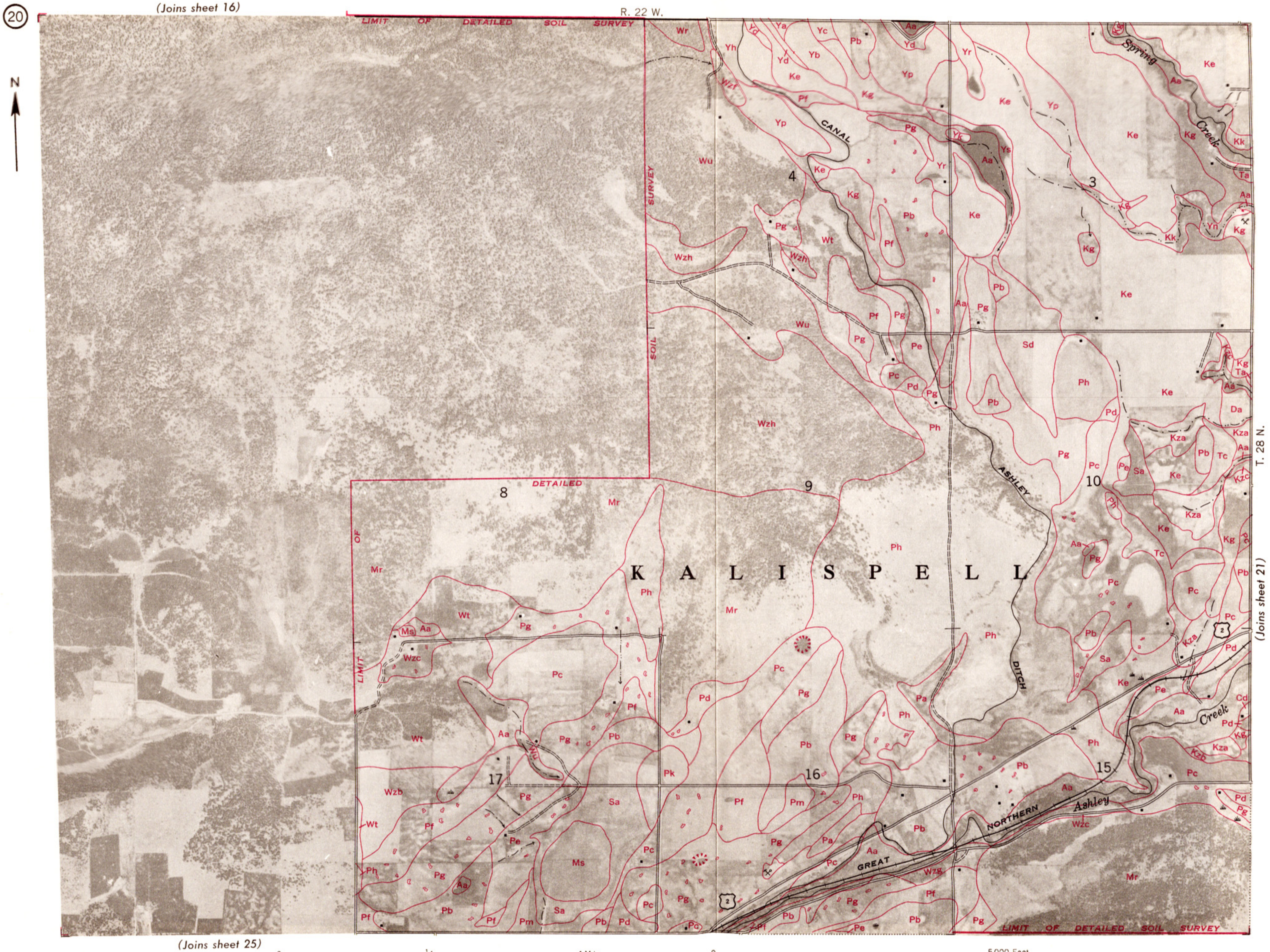
0 1/2 1 Mile Scale 1:20 000 0 5000 Feet



18
(Joins sheet 14)
R. 21 W. | R. 20 W.
N
KALISPELL
JOCKO
STILLWATER GAME PRESERVE
FLATHEAD RIVER
WHITEFISH RIVER
GREAT NORTHERN
Rose Crossing
Helena Flats School
Mission Chapel
(Joins sheet 17)
(Joins sheet 19)
T. 29 N.
(Joins sheet 22)
(Joins sheet 23)
0 1/2 1 Mile
Scale 1:20000
0 5000 Feet


19
R. 20 W.
(Joins sheet 15)
LIMIT OF DETAILED SOIL SURVEY
N
T. 29 N.
(Joins sheet 18)
(Joins inset, sheet 30)
(Joins sheet 23)
(Joins sheet 24)
Fair View Church
Fair View School
Blaine Lake School
YEOMAN HALL
J O C K O
LAKE BLAINE
Cayuse Prairie School
20
21
22
23
26
27
28
29
32
33
34
35
2
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 20



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 21

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

22


(Joins sheet 18)
R. 21 W.
T. 28 N.
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 27)
N
Evergreen School
Montford School
Egan School
KALISPELL
PRESERVE
STILLWATER
GAME
FLATHEAD
RIVER
JOCKO
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

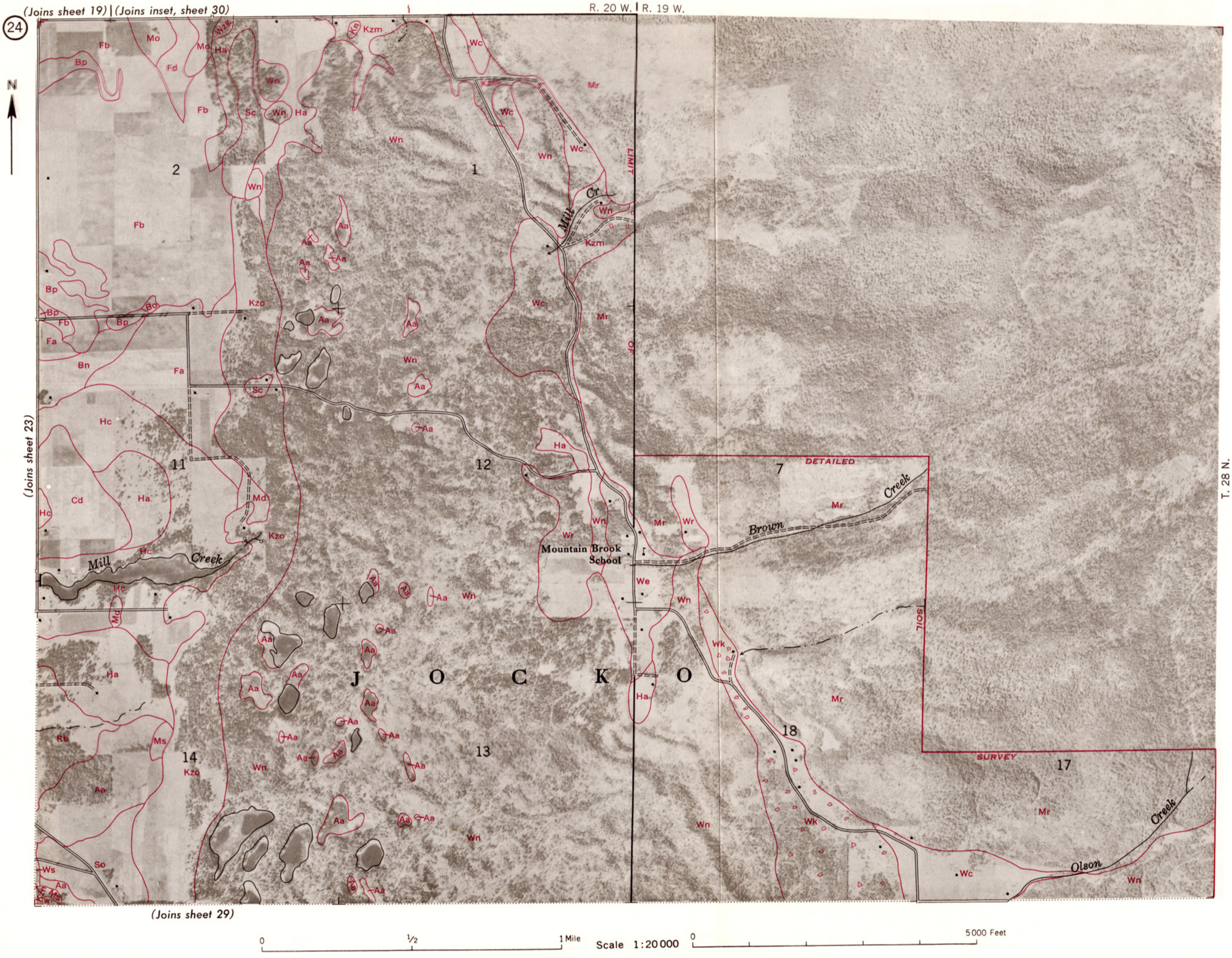
UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 23

Scale 1:20000

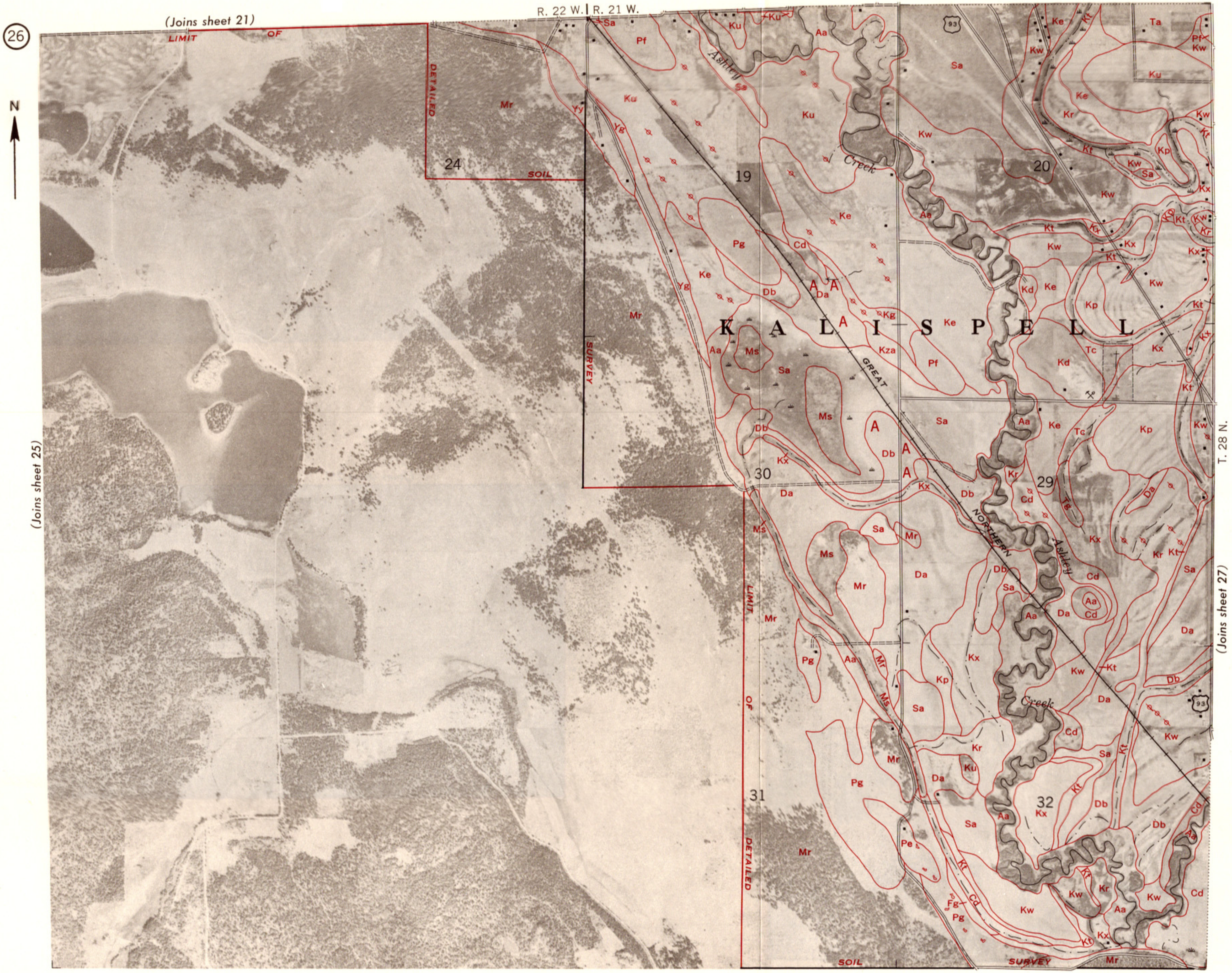
0 ½ 1 Mile

0 5000 Feet

UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 24



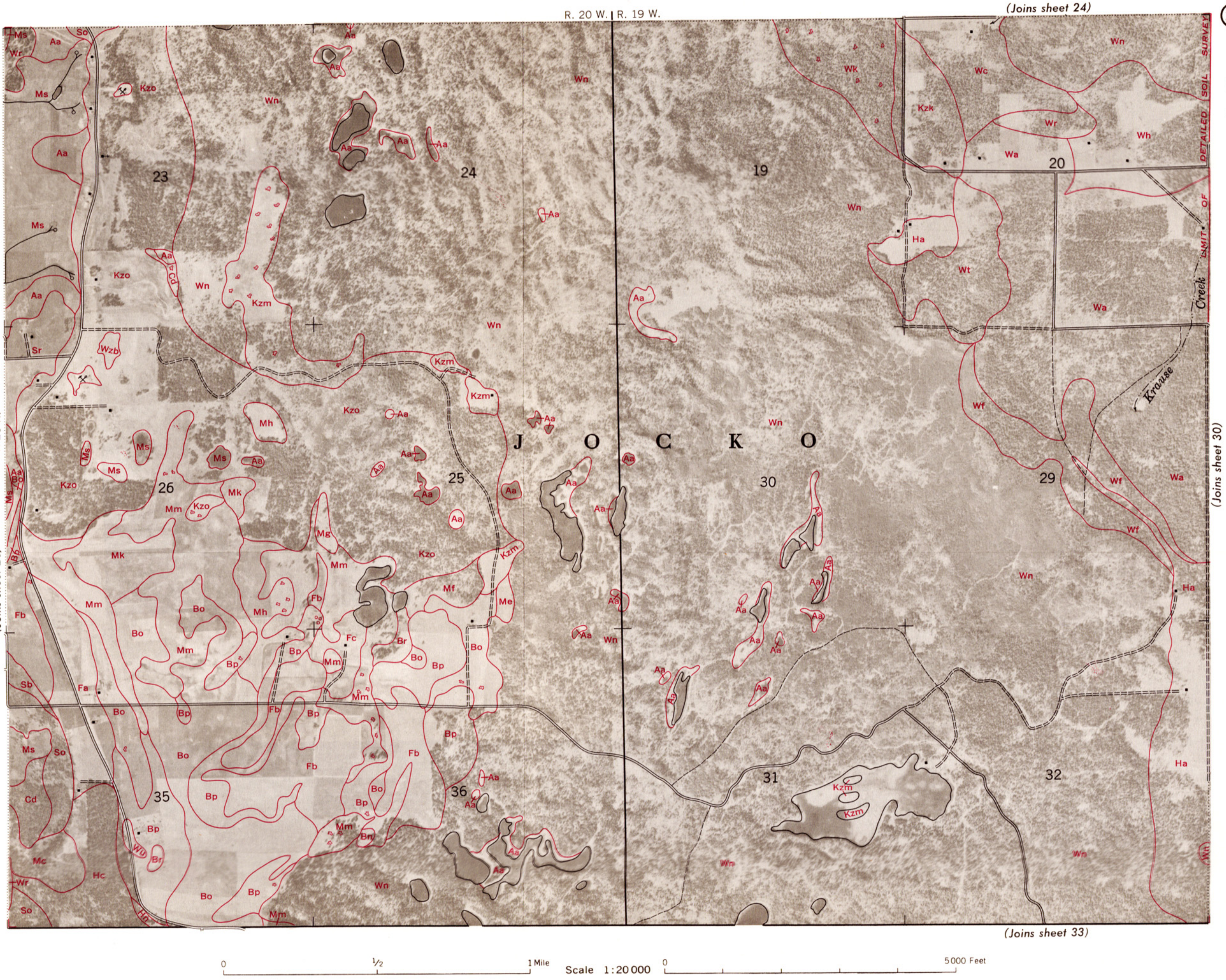
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



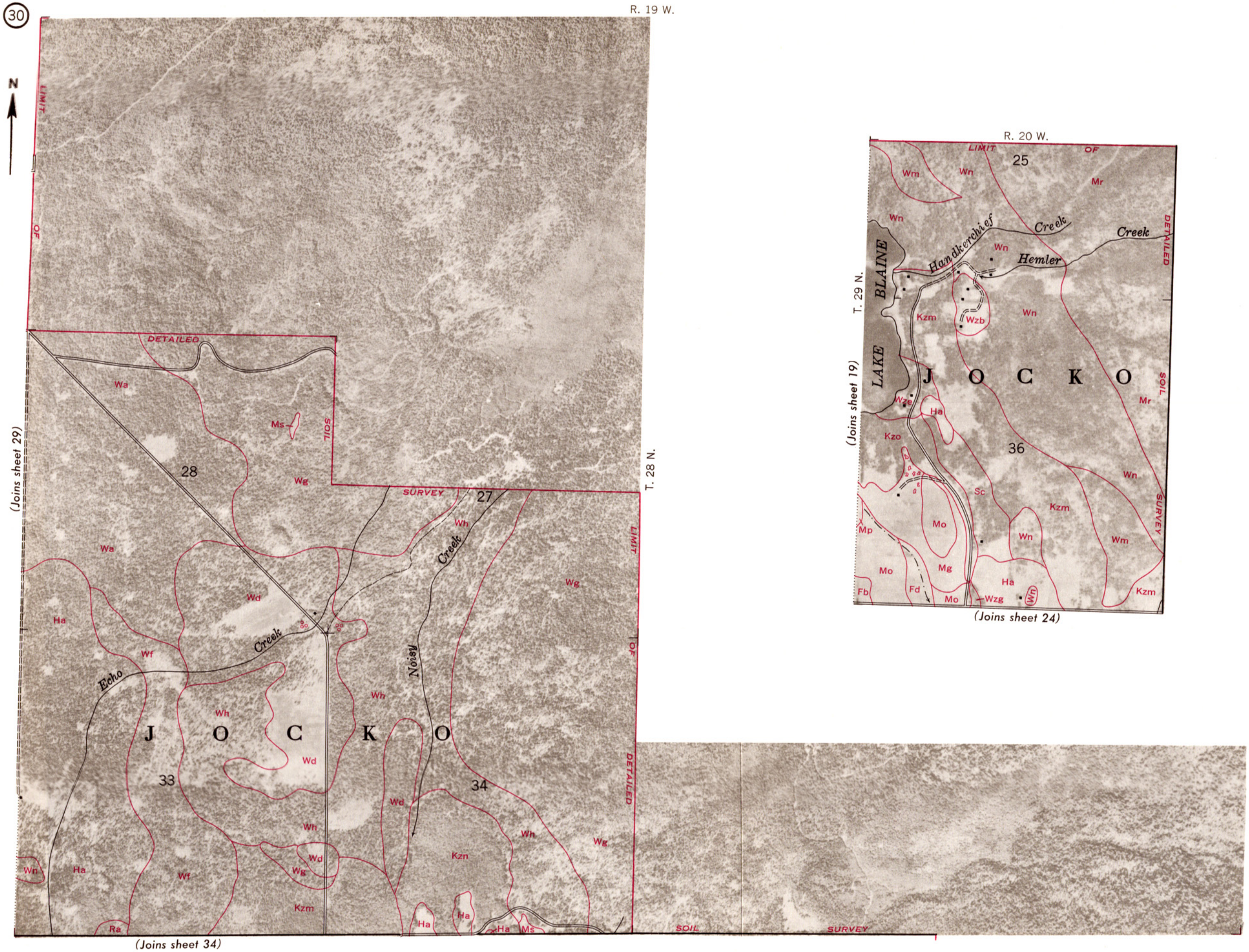
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet


27
R. 21 W.
(Joins sheet 22)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 31)
T. 28 N.
N
STILLWATER GAME PRESERVE
JOCKO
KALISPELL
FLATHEAD
FLATHEAD RIVER
ASHLEY CREEK
Ashley Creek
Demersville School
GREAT NORTHERN
93
21
22
23
24
25
26
27
28
33
34
35
36
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet


28
(Joins sheet 23)
R. 20 W.
N
(Joins sheet 27)
T. 28 N.
(Joins sheet 29)
(Joins sheet 32)
Egan Slough
Egan Slough
JOCKO
FLATHEAD RIVER
FLATHEAD
Mill Creek
Riverside School
Hodgson School
19
20
21
22
27
28
29
30
31
32
33
34
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet


R. 20 W.
R. 19 W.
(Joins sheet 24)
29
N
DETAILED SOIL SURVEY
LIMIT OF
T. 28 N.
(Joins sheet 28)
(Joins sheet 30)
(Joins sheet 33)
J O C K O
Krause
Creek
23
24
19
20
26
25
30
29
35
36
31
32
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

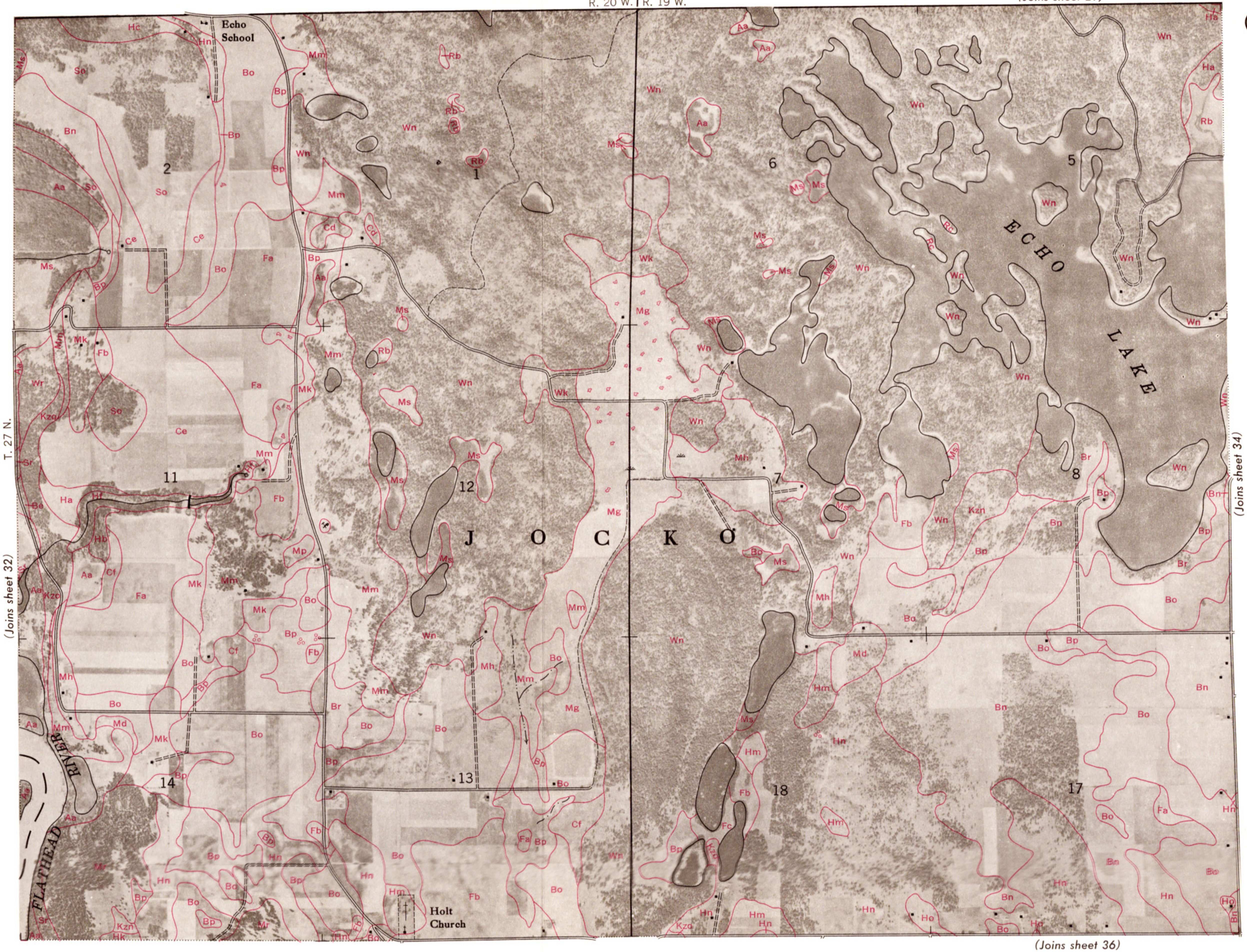
UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 30



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 31

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



Scale 1:20 000

0 1/2 1 Mile

0 5000 Feet

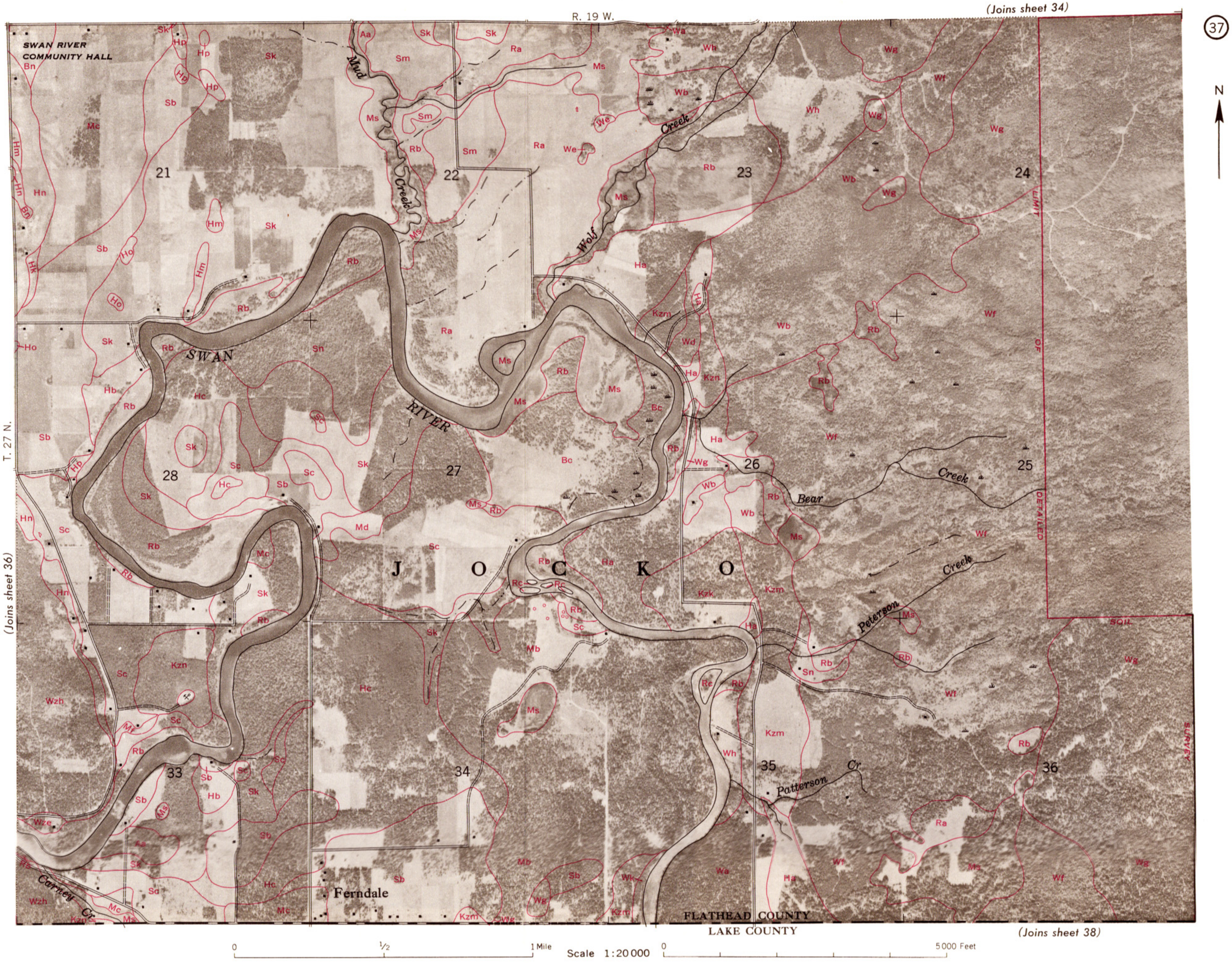

34
(Joins sheet 30)
R. 19 W.
(Joins sheet 33)
(Joins sheet 37)
T. 27 N.
N
Echo Creek
ECHO LAKE
J O C K O
MUD LAKE
Deer Creek
Mud Creek
Wolf Creek
Swan River School
LIMIT OF DETAILED SOIL SURVEY
2
3
4
9
10
11
13
14
15
16
Wn
Ha
Ra
Rb
Wf
Kzm
Kzn
Kzo
Ms
Mr
Wg
Mc
Me
Bn
Bo
Hm
Hn
Sk
Sb
Sc
Md
Cd
Wh
Wa
Scale 1:20000
0
1/2
1 Mile
0
5000 Feet

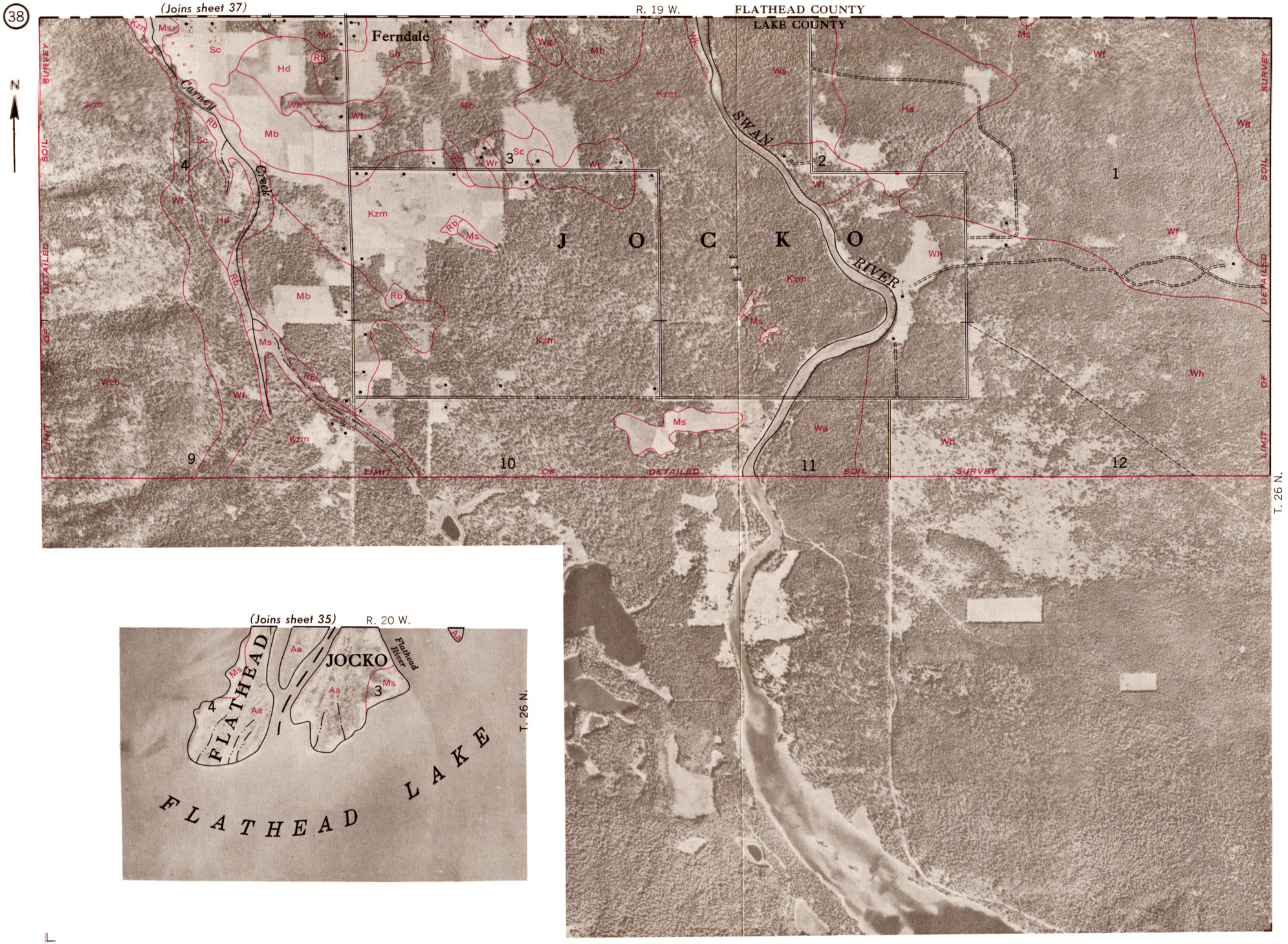

R. 20 W.
(Joins sheet 32)
35
N
T. 27 N.
(Joins inset)
FLATHEAD
FLATHEAD R
19
20
21
22
30
28
27
34
33
FLATHEAD LAKE
FLATHEAD RIVER
JOCKO RIVER
(Joins sheet 36)
(Joins inset, sheet 38)
(Joins sheet 31)
R. 21 W.
T. 27 N.
(Joins sheet 35)
LIMIT OF DETAILED SOIL SURVEY
GREAT NORTHERN
93
23
24
25
26
Somers
FLATHEAD
FLATHEAD LAKE
Aa
Ms
Mr
Ma
Sg
Sr
Kv
Cd
Sd
Th
Bo
Sf
Be
Fe
Sp
Ca
Cb
Cc
So
Ce
Kt
Cd
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 36

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

UPPER FLATHEAD VALLEY AREA, MONTANA - SHEET NUMBER 37





0 ½ 1 Mile Scale 1:20 000 0 5000 Feet